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ABSTRACT

This report contains a study done at the request of the Wisconsin Policy Research Institute, which studies public policy issues affecting the state of Wisconsin. Environmental education texts for Grades 6 through 10 were examined for scientific and economic accuracy, objectivity, and balance in accomplishing the following: 1) stating facts that are generally agreed upon by scientists in the field; 2) explaining the difficulties and complexities of scientific research methodologies; and 3) explaining differing conclusions and theories among scientists. Textbooks surveyed came from the disciplines of science, geography, and health, the focus being on the key environmental issues of population growth, natural resources, American forests, rain forests, endangered species, global warming, ozone depletion, acid rain, solid waste, and recycling. Twelve Wisconsin school districts were selected at random to give a representative sample of the student population in the state. Findings indicate that the environmental education of Wisconsin students is marked by a consistently pessimistic view of the future. Such a worldview short-circuits thinking and leads students to accept as fact ideas that are still being debated within the scientific and economic communities. To fulfill its mandate, environmental education should provide a balanced presentation of scientific and economic thought about environmental issues. In addition, students should understand that if economic growth and technology adversely impact the natural world, they also produce benefits for both humans and nature. (PVD)

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ED 421 331

Wisconsin Policy Research Institute Report

June 1996 Volume 9, Number 5

ENVIRONMENTAL EDUCATION IN WISCONSIN

What the Textbooks Teach

REPORT FROM THE PRESIDENT:

One of the major changes during the last several years in our schools has been the growing role of environmental education. The schools have been charged with teaching our children about environmental problems that include a plethora of issues which will have a major impact on their lives as they grow into adults. It is very important that the issues in environmental education be presented in a way that provides scientifically and economically accurate information about various theories of, and remedies for, environmental problems.

We asked Dr. Michael Sanera, a nationally known expert in evaluating environmental education, to come to Wisconsin as a visiting fellow and examine our environmental-education materials from the sixth to tenth grades.

Dr. Sanera is an associate professor in political science and public education at Northern Arizona University and the president of the Arizona Institute for Public Policy Research. He has written extensively on environmental education and will publish a major book on the subject this fall.

The objective of his study was to evaluate what Wisconsin students learn about the environment. He randomly selected 12 Wisconsin school districts to give a representative sample of the state and reviewed 67 textbooks that dealt with environmental topics in those districts. He compared the texts to the current state of scientific and economic knowledge and used worksheets to review and rate the materials. His main conclusion is that many textbooks do not give an accurate description of all of the various positions on environmental issues as they exist today. Rather than presenting scientific theories on issues, the texts in may instances give a biased ideological explanation for environmental problems — and solutions to them.

Environmental education should be a positive tool in Wisconsin, but students must have a balanced view of the complicated issues surrounding many environmental problems. Our children should be educated, not indoctrinated — because that is how they will learn to respect, and not fear, the world they live in.

James H. Miller

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ENVIRONMENTAL EDUCATION IN WISCONSIN

What the Textbooks Teach

MICHAEL SANERA, PH.D.

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EXECUTIVE SUMMARY

Introduction

Our schools have been charged with preparing the next generation to be conscientious stewards of the planet as well as productive adults and good citizens. We know that tomorrow's adults will grapple with many of the same problems that confront their parents today. It will be up to them to deal intelligently with pollution, species preservation, human population growth, and other environmental problems. It is very important, therefore, that education about these vital issues include a solid grounding in the body of accepted scientific and economic knowledge as well as information about evolving research, theories, and possible remedies.

Research Methodology

The objective of this study is to evaluate what the average Wisconsin student learns about the environment. To implement this objective, I use content analysis to evaluate how the textbooks used in 12 Wisconsin school districts educate students about environmental issues. These 12 districts were selected at random based on size. Large, medium, and small school districts were selected to provide a good cross-section of the student population in Wisconsin. I constructed my content analysis around three basic questions as they apply to each environmental issue:

1. Do the texts fairly and accurately state the facts which are generally agreed upon by scientists working on the issue?

2. Do the texts fairly and accurately explain difficulties and complexities of scientific research methodologies?

3. If the available evidence leads scientists to differing conclusions and different theories, do the texts fairly and accurately explain these to students?

To determine what the average Wisconsin child is learning about environmental problems, I surveyed science, geography, and health textbooks used in 12 Wisconsin school districts. I evaluated the materials in the 6th through 10th grades because students at these grade levels should have sufficient background information in basic science as well as the maturity to grasp complex environmental issues.

I compared the material presented in the texts to the current state of scientific and economic knowledge by using worksheets to review and rate the texts. Special environmental education materials that teachers might introduce into the classroom on their own are not part of this review because they do not represent what is taught to the average Wisconsin student.

My focus is on the key environmental issues of population growth, natural resources, American forests, rain forests, endangered species, global warming, ozone depletion, acid rain, solid waste, and recycling. I examined the texts for scientific and economic accuracy, objectivity, and balance.

Findings

Most parents assume textbook coverage of the environmental issues is scientifically accurate and objectively presented. My review of 62 textbooks used in 12 Wisconsin school districts dealing with topics of environmental importance does not support this assumption.

With few exceptions, I found that textbook treatment of environmental issues is influenced by an ideological view that presents human beings as evil and blames the United States in particular and Western industrial societies in general for every environmental ill. It is my view that the facts provided in textbooks should not be subject to ideological "spin," but should be presented, insofar as scientists know them, without attempts to propagandize students.

Acid Rain: Most texts I reviewed do a poor job of explaining even the basic scientific facts about acid rain. Seventy-five percent of the texts do not mention the naturally acidic nature of precipitation. Most texts list a host of detrimental effects and state as fact that acid rain is the cause. Opposing views, including the findings of the largest scientific study of acid rain ever conducted, are either ignored or denigrated.

American Forests: Based on what students learn from most of their textbooks, most would conclude that government control of forests is essential to saving our woodlands. They would know nothing about the problems of government management or how market incentives work to encourage replanting.

Endangered Species: The vast majority of texts that discussed endangered species explain the human causation theory. Although some texts admit that no one really knows the number of species that have been lost, all the texts estimate very large numbers. The numbers cited, however, vary greatly in each text. Although the high estimates appear to be based on island biogeography, no text includes the weaknesses of this method of determining species loss.

Although the vast majority texts advocate strong government action as a solution to species loss, private ownership as a powerful incentive for species preservation is only mentioned in passing and is never adequately explained. The role of economic incentives in species preservation is ignored by all but one text.

Energy and Natural Resources: Textbook treatment of natural resource and energy issues is mixed. Most texts present a more balanced presentation of these topics than of other environmental issues. Even so, the outlook is usually pessimistic, with dire predictions of resource depletion. No text mentions that resource prices have been constant or falling for years, indicating that scarcity is not really a pressing danger.

Global Warming: All the texts I reviewed did a good job of explaining how carbon dioxide and other gases trap the Sun's radiation, which warms the Earth. Most texts explain that the level of carbon dioxide and other greenhouse gases in the atmosphere has increased and that some warming has occurred, although estimates of the exact amount of warming differ. There is general agreement within the scientific community about these facts and they are covered in varying degrees of detail in the books I reviewed.

However, the vast majority of textbooks emphasize global warming theory, citing the catastrophes predicted by global warming theorists. To avert these catastrophes, according to the majority of texts I reviewed, immediate steps to reduce greenhouse gases are necessary.

The vast majority of texts, however, provide little information about the work of scientists who do not subscribe to global warming theory. Most texts do not explain the weaknesses of the computer models on which global warming theory is based, nor do they mention their weaknesses as predictive instruments. No text mentions that the pattern of warming causing so much concern does not parallel the rise of CO_2 in the atmosphere as would be the case if global warming theory were certain. Nor are students told that climate change predictions are highly speculative and that 20 years ago a group of scientists looked at the temperature record and predicted that a new ice age was coming. Few texts include possible beneficial aspects of global warming, should it take place. A more balanced exposition would inform students of both sides of the global warming debate and motivate them to consider a wide range of possible answers and solutions.

Ozone Depletion: Most textbook explanations of the scientific facts about ozone are incomplete. The texts generally skirt the issue of natural ozone variability in favor of an alarmist picture of human-caused thinning. The ozone depletion thesis is usually explained in detail, but opposing arguments are either not explored or denigrated. As a result, students will not understand the natural factors that cause variation. All the authors seem to accept the ozone depletion thesis without question. Since the information in the texts is so limited, students have no choice but to accept it as well.

Population: Neo-Malthusian theory receives the major emphasis in most of the textbooks Wisconsin students read. The coverage is deficient of alternative theories. With two notable exceptions, neo-Malthusian

theory is the only theory presented by textbook authors even to the point, in some cases, of manipulating facts to make them fit. Only one text mentions that worldwide, the population growth rate has been decreasing since the late 1960s, and most texts present data in graph form which ignores this fact.

Rain Forests: All texts cite high numbers for rain forest destruction, although each text seems to use different figures and no attribution is provided. Developing nations' preservation efforts are ignored and students are given the impression of ongoing, unlimited, and uncaring rain forest destruction.

Recycling: The texts provide incomplete coverage of the complex economics of recycling. Instead, they give students an oversimplified picture that recycling is always beneficial because it saves resources. Students are seldom provided with information about the economic trade-offs which are inherent in recycling decisions.

Solid Waste: Implicit in most textbook discussions is that there is a serious problem represented by overflowing landfills and a shortage of new landfill space. Texts rarely explain why more landfills are not being built, or the difference between older and modern landfills. They do not explain that even biodegradable wastes degrade slowly, if at all, in modern landfills. Products, such as plastics, that do not degrade are demonized. Scientific studies of landfill content are not mentioned, leading students to believe that non-degradable waste consumes the most space.

Conclusion

In summary, Wisconsin students are given frightening scenarios of future environmental catastrophes. Students are taught that they have a gloomy future living in a world where drastic lifestyle alterations are necessary if they are to save the planet.

In short, the texts give a false impression of scientific certainty where none exists, making children fearful and suspicious of technology. Debates over environmental issues are often presented as morality plays in which the villains (human beings in general, Western nations in particular) have been identified and solutions (population controls, reduced use of resources, life style changes) are predetermined.

Environmental issues are often presented in an emotional rather than a scientific manner and students are encouraged to endorse public policy decisions that outstrip the current knowledge base. Weak science and misleading or incomplete information lead students to draw conclusions contested within the scientific community.

In my view, a balanced environmental education would encourage students to become participants in the quest for environmental knowledge on which to base solutions. Social and economic benefits and costs ought to be included in environmental discussions so that the next generation is aware of numerous trade-offs and encouraged to seek a balance among them.

Properly presented, opposing scientific theories about environmental issues are important components in the search for scientific truth. They introduce students to the way knowledge is obtained, and how scientific validity is established.

INTRODUCTION

Concern about the preservation and protection of our natural environment has led many schools to emphasize environmental education in the classroom. Students in all grade levels and in most subject matter areas are taught about ecology and environmental problems such as acid rain, global warming, and resource depletion. In fact, 29 states have mandated that teachers teach about the environment.

Ideally, students should be provided with a fair and balanced presentation of the issues, including competing theories developed by leading scientists. Students should not be presented biased or incomplete information which is designed to lead them to predetermined conclusions. This latter type of environmental education has more in common with indoctrination than education and has no place in our schools.

WISCONSIN SCHOOL DISTRICTS SELECTED FOR THIS STUDY

School District	# of Students (1994-95)	Size Rank
Large Districts *(More than 8,000 students; 33% of total state students)*		
Milwaukee	98,009	1
Kenosha	18,155	5
Janesville	10,368	9
Stevens Point Area	8,558	14
Medium Districts *(1,000 to 8,000 students; 53% of total state students)*		
Superior	5,678	23
DeForest Area	2,916	63
Ellsworth Community	1,959	103
Viroqua Area	1,436	144
Mayville	1,198	183
Small Districts *(Fewer than 1,000 students; 14% of total state students)*		
Auburndale	890	234
Eleva-Strum	642	306
Ithaca	360	378

The Study

School Districts: The objective of this study is to evaluate what the average student in Wisconsin learns about the environment and about environmental issues. To meet this objective, I examined science, health, and geography textbooks at the 6th through 10th grade level which are used in 12 Wisconsin school districts. These school districts were selected by a random process which assured a distribution of districts by student size.[1] The table to the left indicates the districts selected for study.

Taken together, these 12 school districts represent a good cross-section of the student population in Wisconsin.

Textbooks: The 6th through 10th grade science, health, and geography textbooks used in these 12 school districts were collected and analyzed for their environmental issues content.[2] (See Appendix A for information on textbooks analyzed and districts where they are used.)

I selected textbooks for my analysis because they provide the baseline for education in our schools. Textbook selection committees assume that in selecting textbooks for use, the texts present a body of knowledge that students in that subject and grade level should know. While not every page of every text is used in the classroom, the text is generally viewed as an important guideline to be used to make many other educational decisions. For example, when a student decides to write a report on acid rain, that student will usually consult science textbooks for basic information. In addition, teachers who decide to prepare their own lesson plan for a unit on global warming might start with what several texts say about this subject. Therefore, this study uses the texts used in Wisconsin classrooms as the standard for evaluating what Wisconsin students are taught about environmental issues.

Science, health, and geography texts were selected because these academic fields touch on many environmental issues. While many environmental issues are based on science, pollution issues are important matters of public health covered in health texts, and global issues such as population growth and natural resources are matters covered in geography texts. In addition, environmental issues are matters of public policy because solutions to acid rain or ozone depletion, for example, are determined by political leaders. Our democracy requires an informed citizenry to guide political leaders and their decisions. Students need to understand the interaction among the fields of science, health, and geography and political decision-making.

I selected the 6th through 10th grade textbooks because it is at these grade levels that students have had the basic educational background in science, economics, and social studies to deal with complex environmental issues. Additionally, students at these grade levels have the maturity to understand that environmental issues are not just black and white, but often come in shades of gray.

Environmental Issues: I evaluated how the following environmental issues were covered in the texts:

Acid Rain
American Forests
Endangered Species
Energy and Natural Resources
Global Warming
Ozone Depletion
Population and Food Issues
Rain Forests
Recycling
Solid Waste

These environmental issues represent the most common issues found in environmental education texts and curricula. These issues are also on national and state public policy agendas, which makes education about them relevant for students. Students are concerned about these issues because they read about them in newspapers. Thus our educational system should assist them in understanding the complexities of the issues, which will enable them to make informed personal decisions about them.

Content Analysis: This study evaluates the textbook coverage of environmental issues by comparing the content of the text to the current state of scientific and economic knowledge. To implement my content analysis, I used issue worksheets to review and rate the texts. Issue worksheets were developed for each of the 10 environmental topics covered in this study. These issue worksheets are contained in Appendix B.

The issue worksheets were constructed around three basic questions:

1. Do the texts fairly and accurately state the facts which are generally agreed upon by scientists working on the issue?

2. Do the texts fairly and accurately explain complexities and difficulties of scientific research methodologies? That is, to understand an environmental issue such as acid rain, students must understand the problems that scientists have with controlling for multiple variables and determining true cause and effect.

3. If the available evidence leads scientists to differing conclusions and different theories, do the texts fairly and accurately explain these to students? In other words, when scientists differ and they develop different theories to explain the same natural phenomena, are students taught the different theories and the reasons for the disagreements?

Each of the worksheets used to conduct this content analysis was developed using one or more of these questions. While applying the worksheets to the content of the text is somewhat subjective, every effort was made to maintain consistent ratings.

Each of the environmental issues sections in this report contains a table which summarizes our numerical ratings of the texts. In addition, I provide the reader with a narrative description of the textbooks' coverage of the issue, which typifies how the texts deal with the environmental issue. This narrative description of the texts highlights some of the good and bad examples of textbook coverage of environmental issues.

ACID RAIN

Introduction

Acid rain is a problem which perplexes not only the United States and Canada, but also many European countries as well. Pollution from large factories and power plants, especially those burning coal, create sulfur dioxide and other pollutants. These pollutants combine with water vapor in the air to produce sulfuric and nitric acid. Acid rain is moisture that has picked up some of these pollutants, making naturally acidic rain more acidic.

The natural acidity in rain occurs when natural carbon dioxide in the atmosphere mixes with rain to form carbonic acid, or nitrogen oxides combine with precipitation to form nitric acid.[3] Scientists measure acidity on a scale of 1 to 14. A value below 7 indicates acidity; a value above 7 indicates that the fluid is basic or alkaline. Some scientists conclude that acid rain caused by these pollutants is to blame for acidic streams and lakes and dead or dying forests. Other scientists say that while acid rain does exist, the causal relationship to the damage to lakes, streams, and forests is weak. These scientists point to the 10-year study commissioned by Congress which found some evidence of harm to high elevation red spruce trees in the Appalachians, but concluded that acid rain was not a danger to forests or crops. The study also determined that although acid rain had probably influenced the acidity levels in some lakes, these lakes were also becoming acid due to natural factors. To receive a quality environmental

education, students should know about this controversy and their instruction should include both sides of the acid rain debate.[4]

The Catastrophic Acid Rain Thesis

Scientists know that pollution reacts in the atmosphere with moisture to increase the acidity of rain and other forms of precipitation. Under dispute is how this increase affects the environment. Proponents of the catastrophic acid rain thesis say that air pollution from coal-burning plants and from automobiles in the Midwest is carried by winds to the northeastern states and Canada — where it falls as polluted rain and damages waterways, buildings, crops, and forests. A number of rivers in Nova Scotia have lost most of their salmon over the past 40 years as they have become more acidic. As a result of this polluted rain, lakes in the Adirondack Mountains of New York that once supported aquatic life now have no fish in them. Similarly, air pollution from Germany, France, and Britain is blamed for killing fish in Swedish lakes and destroying Swedish forests. Acid rain clouds from Britain and Germany have been blamed for depletion of trout in lakes in southern Norway. In Europe, where heavy sulfur dioxide emissions from power plants pollute the air, trees are dying. Acid rain from pollution is believed to be the cause of this environmental damage. That is why scientists who subscribe to the catastrophic theory advocate immediate action to reduce the pollution that produces acid rain. More efficient smokestack scrubbers and other antipollution devices are recommended to prevent further damage. In this view, only stringent governmental restrictions on sulfur dioxide emissions from power plants and industrial sources can save our forests and fish and preclude crop damage.

Critics of the Catastrophic Thesis

The National Acid Precipitation Assessment Project (NAPAP), a massive 10-year, $500 million study commissioned by the U.S. Congress, did not find evidence to support the catastrophic acid rain thesis. NAPAP found little harm to trees and crops, and only minimal damage to streams and lakes. The study concluded that forestry practices affecting the soil surrounding lakes and streams have much more to do with the acidic content of these waterways .[5] In the Adirondacks, some naturally acidic lakes became temporarily alkaline during the 1800s when loggers used the slash and burn method of removing trees, creating a large amount of alkaline wood ash that flowed into the waterways during summer rains and spring snow melts. Over time, when alkaline ash was no longer being created, the lakes returned to their naturally acidic condition.[6] In addition, acid rain can not explain the high percentage of acid waterways in locales, such as the state of Florida, which have low pollution and acidic rain levels, but the highest percentage of acid lakes. Mandating emission reductions, according to the study, would be expensive and produce little benefit. According to NAPAP, even with no new controls on sulfur dioxide, air pollution emissions will decline after the year 2005 because old power plants are being replaced by cleaner technologies.[7]

Acid Rain Criteria

The table on the next page provides the results of my content analysis of the 39 texts which discussed the acid rain issue.

Discussion

The information that children receive about acid rain is overwhelmingly one-sided. Most texts don't bother to explain even basic scientific facts about acid rain or the naturally acidic nature of precipitation. The texts tend to emphasize different detrimental results from acid rain, but most are certain that man-made pollution causes the harm done. Opposing views, with one exception, are either ignored or denigrated.

Physical Science, published by Harcourt Brace Jovanovich, is certain that acid rain is producing harmful effects. "Acid rain is harmful to land organisms as well. Many food crops have been destroyed by the effects of acid rain. ... Much of the acid rain that is destroying Canadian forests originates in the United States." (p. 540) "The only way to control acid rain is to reduce emissions of sulfur oxides and nitrogen oxides into the air. The

main source of sulfur oxides is the burning of coal and other fossil fuels in electric energy plants." (p. 541)

Biology, published by Prentice Hall, correctly informs students about the origins of acid rain, "Certain pollutants in the air combine with water vapor to form droplets of acid. When these droplets fall to Earth in rain, the rain is called acid rain." On the other hand, the text ignores the scientific controversy over the effects of acid rain and asserts that "[t]he effects of acid rain on the environment are numerous and serious to life." What follows is a litany of acid rain damage with no indication that there is any doubt about cause and effect. (pp. 1056-57)

Science Plus: Technology and Society, published by Holt, states the cause and effect relationship between environmental damage and acid rain as fact and advises students to take an activist role. "With your classmates, discuss what can be done about the acid rain problem. Make a list of possible solutions." One suggestion: "Place more regulatory controls on factories and industries that release sulfur and nitrogen oxides into the air." (p. 55)

Physical Science: Challenge of Discovery, published by D.C. Heath, explains the link between man-made pollution and acid rain, (pp. 557-58) but indicates that more research is needed. "Although more study is needed to determine the cause-and-effect relationship, acid rain is believed to be partially responsible for much of the forest and crop damage that is observed yearly, particularly in the northeastern United States and Canada." (p. 559)

The Eastern Hemisphere Yesterday and Today, published by Silver, Burdett and Ginn, lists the damage done by acid rain as a "serious problem" and makes no mention of natural acidity of rain or the existence of contradictory scientific findings. (p. 165)

EXPLAINS BASIC SCIENCE OF ACID RAIN

Explains naturally acidic rain	
Explains Fully	8
Inadequate Explanation	1
Incorrect Explanation	0
Not Mentioned	30
Explains how sulfur dioxide emissions increase acidic levels of rain, snow, etc.	
Explains Fully	26
Inadequate Explanation	13
Incorrect Explanation	0
Not Mentioned	0
Explains the pH scale	
Explains Fully	10
Inadequate Explanation	5
Incorrect Explanation	0
Not Mentioned	24

EXPLAINS ACID RAIN THESIS

Explains theory that acid rain is harmful to streams and lakes	
Explains Fully	30
Inadequate Explanation	9
Incorrect Explanation	0
Not Mentioned	0
Explains theory that acid rain kills fish, trees, crops, etc.	
Explains Fully	27
Inadequate Explanation	12
Incorrect Explanation	0
Not Mentioned	0
Explains theory that acid rain harms buildings, statues, etc.	
Explains Fully	18
Inadequate Explanation	6
Incorrect Explanation	0
Not Mentioned	15
Explains theory that acid rain is so severe that it requires government regulation	
Explains Fully	12
Inadequate Explanation	8
Incorrect Explanation	0
Not Mentioned	19
Explains that acid rain is a worldwide problem (Europe, Canada, etc.)	
Explains Fully	16
Inadequate Explanation	7
Incorrect Explanation	0
Not Mentioned	16

EXPLAINS THE ARGUMENTS OF THE CRITICS OF THE ACID RAIN THESIS

Covers naturally acidic waterways in areas remote from industrial pollution	
Explains Fully	2
Inadequate Explanation	0
Incorrect Explanation	0
Not Mentioned	37
Discusses findings of NAPAP study	
Explains Fully	1
Inadequate Explanation	0
Incorrect Explanation	0
Not Mentioned	38
Little damage to trees and crops	
Explains Fully	1
Inadequate Explanation	0
Incorrect Explanation	0
Not Mentioned	38
Minimal damage to streams and lakes	
Explains Fully	1
Inadequate Explanation	0
Incorrect Explanation	0
Not Mentioned	38
Recommends against expensive government regulation because costs outweigh benefits	
Explains Fully	1
Inadequate Explanation	0
Incorrect Explanation	0
Not Mentioned	38
Explains alternative explanations for damage — slash and burn farming in the 1800s	
Explains Fully	1
Inadequate Explanation	0
Incorrect Explanation	0
Not Mentioned	38

Earth Science, published by Scott Foresman, makes the same assertion. "Acid rain kills fish, damages crops and trees, and corrodes buildings, statues and other structures. Electric power plants produce most of the sulfur dioxide that results in acid rain." (p. 614) Students are not informed of any debate about the effects of acid rain on the environment.

Biosphere: The Realm of Life, a biology text published by Scott Foresman, also expresses certainty about the link between pollution and the effects of acid rain.

> Interestingly enough, the solution is clear to everyone. We simply need to reduce the levels of our effluent from power plants, smelters and automobiles. Most of the technology exists, but its implementation would be too expensive for the polluters to willingly bear. Are we willing to pay higher prices for manufactured goods to save our lakes and rivers? (p. 766)

Having failed to fully inform students about acid rain, students also would find the answer clear.

Teen Health, published by Glencoe, explains the man-made derivation of destructive acid rain. The authors express less certainty than the previous text, using the term "may." "Acid rain may kill trees and plants along with fish and other water life..." They also say, "Not all scientists agree about these effects of pollution. Some say that the problems are not great. Others though, are very concerned about what the pollution may do." (p. 432) However, since students are not informed of the basis of opposing views, they would not know enough to doubt the conclusion that man-made pollution is responsible.

Life Science, published by Harcourt Brace Jovanovich, provides a much more balanced discussion of acid rain than the foregoing texts.

> Analyzing the data from the scientific investigation of acid rain is not always easy. For example, scientists often do not have accurate measurements from the past. If scientists do not know how many fish were in a New York mountain lake 20 or 30 years ago, they cannot be sure if the fish population has increased or decreased. Is acid rain increasing the acidity of lakes in the Adirondack Mountains? Or do the region's soil and vegetation make the lakes naturally acid? Only more complete scientific studies will finally answer these questions. (p. 570)

"However," the text also states,

> scientific studies require several years to complete. Many scientists are urging immediate action to reduce the threat of acid rain in the future. ... If acid rain is to blame for declining forests and lakes, scientists must also decide what is to blame for acid rain. Most experts agree that sulfur oxide and nitrogen oxides in the air mostly come from industry, such as factories and power plants. ... Many scientists in Canada and the United States are ready to declare a verdict in the acid rain issue. They theorize that acid rain is causing a decline in forests, lakes and wildlife. They are calling for stricter controls on emissions and a multibillion dollar plan for technology that will clean up industrial smoke. (pp. 570-71)

If all students were apprised of the findings of the NAPAP studies they would have a clearer picture of the acid rain dilemma.

The issue of acid rain involves many factors. Students who are uninformed about this complexity will assume they have been apprised of all the relevant facts and form conclusions accordingly.

AMERICAN FORESTS

Introduction

A major controversy rages over the condition and use of American forests. Students need to understand the positions of various sides of the controversy and the data which support them. The fundamental basis for the disagreement is over two different visions of how forested land should be managed. One side argues that the public

interest is best served by public ownership. The other side cites the drawbacks of government ownership and, while agreeing that there were problems with private ownership in the 1800s, cites the remarkable regeneration of the forests on private land. To be environmentally literate, students must be conversant with both arguments and the supporting evidence.

Public Ownership of American Forests

At one time, much of the eastern and western United States were covered by forests. When the first colonists arrived, about half the continental United States was forest. However, economic development in the last half of the 1800s caused such extensive tree cutting that some feared that private interests were destroying forests so fast that there would soon be none for future generations to enjoy. At one point, for example, farmers were clearing forests at an astounding pace of 8,600 trees per day, a rate that continued for almost 50 years. Although forests are a renewable resource, they seemed in danger of disappearing. By 1920, forests had declined to 32% of America's land area.[8] Proponents of government ownership point out that this over-cutting and failure to replant demonstrate that private interests are wasteful and too concerned with short-term profits to be responsible stewards of the nation's forests.

They cite this history as evidence for empowering government to protect our forests. In the late 19th century, a movement to have government scientifically manage forests and protect them from further depletion was spearheaded by the Progressive Party. The Forest Reserve Act of 1891 authorized the establishment of permanent federal forest preserves to halt what was viewed as the wasteful destruction of forested land. The Progressives wanted logging put under federal management so that science, rather than profit, would guide forestry policy. It was thought that government employees, immune from outside pressures, would be able to more wisely manage the forests.[9]

In 1924, the Clark-McNary Act was passed to provide funds and establish a system of federal/state efforts for fire suppression on both private and public land. From the 1920s to the early 1940s, wildfires consumed between 20 million and 50 million acres of forest each year. Thanks to Clark-McNary, fire damage declined dramatically after that.[10]

A strong conservationist policy led to the expansion of national parks and the creation of forest reserves. In all, some 270 million acres were closed to commercial timber or other natural resource uses and set aside for wilderness areas, parks, wildlife refuges, and other preserves. This area is larger than Arizona, Utah, Colorado, and New Mexico combined. Special protection is afforded old-growth forests. To protect the old trees and the habitat they afford, some 3.3 million acres are off limits for timber harvesting. Advocates of public ownership argue that private ownership depleted forests and government control and public ownership will protect them for the future.[11]

Private Ownership of American Forests

Proponents of private ownership view history differently. They point out that wood was important to the early development of the nation. It built farms and factories and provided food to feed and fuel to warm a growing nation. It built bridges and provided ties for railways to bring goods to market.

But despite this extensive use of wood, the predicted timber shortage did not materialize. Instead, as forests gave way to farms and towns, rising lumber prices led to decreases in the quantity of wood demanded. People switched to substitutes like steel and concrete for building and oil and coal for fuel. Technologies were developed that further reduced timber demand by making more efficient use of forest resources. Wood preservatives lengthened the life of forest products and wood scraps were turned into marketable products. Perhaps most important, higher timber prices created incentives to replant that were absent when wood was plentiful and inexpensive.

Suppression of wildfires also helped encourage investment in tree farms. Far from running out of trees, in the past 70 years, American forests have essentially been reborn. Today, the private sector is responsible for more

than 80% of all trees planted in the United States each year, far surpassing government efforts.[12] Except for fire suppression, which was a cooperative effort between the public and private sectors, the regeneration of American forests has been accomplished by the private sector responding to market forces. As a result, the total number of forested acres is increasing, not shrinking. This forest growth has occurred in almost every region of the country — except old-growth forests, which are largely government-owned.

For those economists who recognize the benefits of private ownership, American history bears out the Founders' belief that when property is privately owned it will be managed prudently to preserve its value. Proponents of private ownership point out that government does not respond to market conditions, but operates under rules set by politicians, many of whom are influenced by special interests. This often proves harmful to forests and costly to taxpayers. Although the Forest Service manages millions of acres of timber and recreation land, it regularly loses money on these lands thus providing a tax-funded subsidy to special interests. Far from being immune to outside pressures, the Forest Service has a long history of being embroiled in political disputes over forest management.[13] Advocates of private ownership say we are not running out of wood because every year, the private sector, responding to market incentives, grows far more wood than it cuts.

Criteria for American Forests

The use and management of American forests has become an emotional issue in recent years, pitting those whose livelihoods depend upon wood products against those who want to limit logging. If students are to understand what they hear and see in the media, it is especially important that they understand both sides of this issue. My ratings of the texts are based on whether these key issues are explained.

EXPLAINS THE ARGUMENTS FOR PUBLIC OWNERSHIP OF FORESTS

Professional and scientific management of forests

Explains Fully	4
Inadequate Explanation	2
Incorrect Explanation	0
Not Mentioned	3

Private sector was over-cutting forests

Explains Fully	4
Inadequate Explanation	3
Incorrect Explanation	0
Not Mentioned	2

Establishment of the National Forests, National Parks, Wilderness Areas, etc., to protect forests

Explains Fully	5
Inadequate Explanation	2
Incorrect Explanation	0
Not Mentioned	2

EXPLAINS THE ARGUMENTS CITING HOW PRIVATE OWNERSHIP PROTECTS AND EXPANDS FORESTS

Explains the weaknesses of government management — responsive to special interests

Explains Fully	0
Inadequate Explanation	0
Incorrect Explanation	0
Not Mentioned	9

Explains private-sector contributions to reforestation — tree farms, replanting

Explains Fully	1
Inadequate Explanation	6
Incorrect Explanation	0
Not Mentioned	2

Explains the importance of wood to America's early economic development

Explains Fully	1
Inadequate Explanation	3
Incorrect Explanation	1
Not Mentioned	4

Market prices cause conservation, substitutes, and replanting

Explains Fully	1
Inadequate Explanation	1
Incorrect Explanation	0
Not Mentioned	7

Currently, more wood is grown than cut every year

Explains Fully	1
Inadequate Explanation	2
Incorrect Explanation	1
Not Mentioned	5

Discussion

The overwhelming majority of these texts convey the impression that government ownership of forests is the only way to prevent greedy private owners from clear-cutting forests for short-term profits.

Biology: Living Systems, published by Merrill, condemns the past use of U.S. forests for economic development. "Large areas of forests also have been wasted. At one time, forests covered most of the eastern and western United States. These forests have been cleared for farmland and much of the timber

was burned or used for other purposes." (p. 758) Building homes, feeding settlers, and constructing a railroad system, among "other purposes," should hardly be described as "wasteful" — since these uses provided shelter, food, and transportation for settlers.

Biology, published by Prentice Hall, decries the cutting of old-growth forests and the only mention of reforestation by private landowners is criticism of lumber companies for reforesting by "planting large numbers of single tree species." On the same page, the statement is made that a "forest survey predicts the loss of as much as 18.8 million acres of southern timberland by 1995." (p. 1065) Although the text does not say how the acres will be lost, the context would lead students to believe that tree cutting is the culprit.

World Geography Today, published by Holt, provides misleading coverage of forestry issues.

> On our own continent the first settlers found a land almost covered by trees. As the population of the United States grew, more and more forest land was cleared. But few trees were planted to replace those that were destroyed. In the early 1990s, the federal government became aware of the need to conserve our forests. Now in many regions, especially New England, the South, and the Northeast, only a certain number of trees can be cut each year. National forests have been created and lumbering in these areas is carefully controlled. The planting of new trees in place of those that have been cut down is called reforestation. The reforestation program has met with great success. By 1955 our forests were growing nearly one fourth more wood than was being removed each year by lumbering, fires, and disease. (pp. 503-04)

From this description students would assume that government is responsible for most reforestation. Students are not told that the vast majority of forests regeneration has been accomplished by private owners responding to market forces. The description of government forestry does not inform students of the inherent problems associated with government management dominated by politics.

Managing Our Natural Resources, Delmar Publications, supplies the most balanced view of forestry issues. The authors point out that of the over a billion acres of forest in 1607, almost 70% is still forest. Instead of condemning the loss of the 30% the authors point out,

> this nonforest use of forest land is not necessarily bad. Our society could not function without highways built over some good farmland. By the same token, people cannot be fed without clearing the forests for farming. ... Each decade we take more wood from our forests than the decade before, yet each year the trees in our forests grow more wood than we harvest. ... Don't feel sad to see trees being cut. After all, they are not a natural resource until they become useful. (pp. 5-6)

World Geography Today, published by Holt, tells students only half the story of U.S. wood use.

> As the nation's population grew, many forests were cut to provide timber for fuel, homes and industry. New trees were not planted to replace those that were destroyed. It was not until the early 1900s that the federal government became aware of the need to conserve our forests. Now in many regions, only a certain number of trees may be cut each year. National forests have been created, and lumbering is controlled. Other nations, such as Sweden, Germany, Israel, Finland, New Zealand and the Soviet Union also practice reforestation. (p. 613)

Students would be better served if this account included the subsequent private-sector regeneration of forests and the drawbacks as well as the benefits of government forest management.

The vast majority of students would conclude that government management of U.S. forests is essential to saving our woodlands. These texts present public ownership as an unqualified good. Students would know little about private-sector reforestation efforts or the reasons for them.

ENDANGERED SPECIES

Introduction

Children are attracted to animals and they are legitimately concerned when they are told that some animals are in danger of extinction. That puts this environmental issue high on their list of priorities. But there are several theories to explain how animals become endangered and several solutions offered for saving them. The debate revolves around the science of species loss and differing economic and governmental solutions.

Endangered Species Science

Human Caused Species Loss Theory

In this view, human population growth is speeding species extinction because humans are taking habitat to build homes and grow food. Estimates of the number of species likely to be lost range from 15% to one quarter of the total number of species being lost within 50 years.[14] The destruction of tropical rain forests is a particularly egregious example of habitat destruction and species loss. Clearing the forests for timber and for other land uses poses the threat that many species could be lost forever. Scientists have documented and named 1.4 million species of plants and animals on Earth, but many more are thought to exist.[15]

Estimates have expanded with the discovery of the great diversity of life within tropical rain forests. Some scientists use studies of islands ("island biogeography") where habitats have been destroyed and species have died off to estimate the percentage of rain forest species likely to become extinct. The standard used is that 90% destruction of rain forest habitat results in 50% destruction of species.[16]

Using the 90% and 50% calculations, deforestation could deprive the world of important parts of its genetic heritage as well as many potentially beneficial medicines. Some estimates run as high as 15% to 20% of all species becoming extinct by the year 2000.[17]

One theory holds that nature consists of interlocking parts that operate as ecosystems to keep nature in balance. In this view, every creature is equally important to the natural order and equally deserving of protection.

Those who fear accelerating species loss cite the disappearance of the passenger pigeon, the near extinction of the American buffalo, and the continuing encroachment of human populations throughout the world as sufficient evidence of the need to protect the Earth's threatened species.

Critics of Human Caused Species Loss Theory

Critics of the theory of human caused species loss point out that scientists disagree about how to define species. To date, no one really knows how many species of plants and animals live on the Earth. Until agreement is reached on what constitutes a species, estimating the percentage of endangered or lost species is more conjecture than science.

Skeptics argue that basing estimates of species extinction's in rain forests on studies of islands is unreliable. Tropical rain forests, unlike islands, are surrounded by land, not water. Thus, despite loss of immediate habitat, species are able to more easily relocate and adapt to new surroundings.

They also point out that predicted island extinctions do not always occur. Puerto Rico, an island, was nearly stripped of its forests at the turn of the century. Yet, massive species extinction did not result. Only seven of the island's 60 bird varieties were lost, demonstrating that loss of original habitat need not always threaten species viability.[18] In the U.S., despite extensive logging of virgin forests during the 19th century, only about three birds became extinct. An indiscriminate effort to preserve all species ignores both biology and common sense.

A more moderate view of species preservation suggests striking a balance between species protection and a decent regard for the needs and welfare of human beings. In this view, the loss of a few species seems a small price to pay for the development of the American continent. As American history demonstrates, poor societies do not have the resources to devote to protecting species, affluent societies do.[19]

How to Save Endangered Species

Government Actions

Advocates of this approach say that the way to save habitat and the species living in them is for governments to establish protected parks and preserves where human encroachment is minimal and activities threatening to species are prohibited. Helpless species, they argue, should not be sacrificed in the name of economic development.

Proponents of government action want aggressive enactment and enforcement of bans on activities that benefit humans at the expense of endangered species. The ban on hunting and selling ivory in parts of Africa is an example. Strict antipoaching laws and penalties to discourage hunting are required to reduce the threat to species survival in government preserves and parks.

In the United States, the Endangered Species Act (ESA) provides an example of the kinds of things governments can do to preserve species. It was passed in 1966 to identify endangered species and initiate actions to protect them. The ESA empowered government to purchase land from private owners to preserve and protect habitat of threatened species. The law also directed the federal government to conduct its business in ways that protected endangered species. Later expansion of the ESA enables government, when necessary, to regulate activity on private land that threatens species viability. Advocates of regulation believe that because individuals are guided by selfish economic interests, governments should be empowered to protect the public interest. In this view, protecting the planet is justification enough for invoking governmental powers.

Economic Incentives and Individual Actions

Advocates of this approach do not blame human population growth for endangering species. The critical factor, they say, is whether species are held in common or protected by property laws. They point out that elephant populations are increasing in Zimbabwe, Namibia, and South Africa because nearby villages enjoy quasi-ownership rights permitting them to derive benefit from the animals and giving them a personal stake in seeing that the herds thrive. In Kenya, where the elephant population has been declining, elephants are public property and are kept on national preserves. As the natives are prohibited from deriving legal benefit from the herds, poaching is a serious problem and there is little interest in protecting the herds for the future.[20]

Proponents of this view cite the American Bison which, when owned by no one, was killed without limit until the survivors were moved to private land. Today bison meat is a popular and profitable commodity and the bison population, protected by private ownership, is growing. The passenger pigeon wasn't so lucky. Chickens and passenger pigeons were highly prized for their meat, but chickens were owned so farmers preserved their flocks. The passenger pigeon, which was owned by no one, is extinct.

As in the case with the elephants, when governments ignore economic incentives, species can be adversely affected. A 1973 revision of the Endangered Species Act places an absolute value on protecting species, regardless of cost and regardless of whether the species' habitat is on public or private land. It expands the definition of "taking" to include any conduct that might be considered threatening to a species and enables the ESA to prohibit modification of habitat if the modification significantly disrupts "essential behavior patterns." Landowners are often tempted to destroy endangered species habitat on their private land in order to avoid major financial losses. This is hardly a wise prescription for species preservation, critics of the law point out.[21]

EXPLAINS THE HUMAN CAUSED LOSS THEORY	
Species loss due to human population explosion	
Explains Fully	9
Inadequate Explanation	7
Incorrect Explanation	0
Not Mentioned	2
Rain Forest Island Biogeography Theory	
Explains Fully	2
Inadequate Explanation	1
Incorrect Explanation	0
Not Mentioned	15
Importance of species in production of medicines	
Explains Fully	5
Inadequate Explanation	2
Incorrect Explanation	0
Not Mentioned	11

EXPLAINS THE ARGUMENTS OF THE CRITICS OF HUMAN CAUSATION	
Species are being lost, but not at the high rates predicted by human causation theorists	
Explains Fully	0
Inadequate Explanation	0
Incorrect Explanation	0
Not Mentioned	18
Explains criticism of Island biogeography	
Explains Fully	0
Inadequate Explanation	0
Incorrect Explanation	0
Not Mentioned	18

HOW TO SAVE SPECIES	
Explains saving species by government action	
Save by strong anti-poaching laws and establishment of parks and preserves	
Explains Fully	13
Inadequate Explanation	2
Incorrect Explanation	0
Not Mentioned	3
International bans on animal products	
Explains Fully	5
Inadequate Explanation	0
Incorrect Explanation	0
Not Mentioned	13
ESA successfully saves endangered species	
Explains Fully	4
Inadequate Explanation	2
Incorrect Explanation	0
Not Mentioned	12
Explains saving species by economic incentives and individual action	
Species lost because of "common property" incentives	
Explains Fully	1
Inadequate Explanation	0
Incorrect Explanation	0
Not Mentioned	17
Negative side of ESA — creates incentives to harm species	
Explains Fully	0
Inadequate Explanation	0
Incorrect Explanation	0
Not Mentioned	18
Promote ownership and private actions to help species	
Explains Fully	0
Inadequate Explanation	3
Incorrect Explanation	0
Not Mentioned	15

Endangered Species Criteria

To determine whether textbooks present both theories of how species become endangered as well as the solutions that flow from each theory, we rated coverage of the list of key points to the left.

Discussion

As demonstrated in the chart, most texts favor the human causation theory of species loss. Critics of the human causation theory do not get equal space. No text explains the opposing view, nor do any texts explain the weaknesses of island biogeography, on which estimates of species loss are based. Only one text explains the drawbacks of "common property" incentives. The rest of the texts either do not mention the problem of the commons or advocate government ownership and government regulation solutions. Private ownership as a powerful incentive for preserving species is not adequately explained. No text explains the role of economic incentives in species preservation. Students should be informed of both strategies for species preservation and understand the reasons behind them.

Biology, published by Prentice Hall, misleads students by crediting "strict laws" for the survival of the bison rather than private ownership. (p. 1065) The text also mentions endangered elephants, but fails to explain the outcomes of differing preservation strategies in African countries. Instead, prohibitions on hunting are emphasized as a way of preserving elephant herds. Although the text leans toward laws and other government actions to preserve species, the authors do mention the role of sportsmen and other private individuals. (p. 1069)

Science Plus: Technology and Society, published by Holt, in a section called "Challenge Your Thinking," suggests, "An article in the local newspaper stated: 'Everything that humans do to the environment causes animals to become extinct. Write a letter to the editor of the newspaper to disagree with the statement. In your letter, describe some of the ways that humans help prevent animals from becoming extinct.'" (p. 93)

Students might have more success with the activity, however, if the text elaborated on some of those ways. Only a few pages later the text states:

> In the year 1990 alone it is estimated that 10,000 different species of living things became completely extinct. In the year 2000, the studies say, the number of species that will become extinct will be 20,000. These numbers may seem even more astonishing when you realize that in 1975, the number of extinctions was "only" 100. (p. 128)

No attribution is provided for those numbers nor is there any indication that there is ongoing scientific debate about how species should be defined. In the light of that debate, it is reasonable to wonder how the numbers can be cited with such authority. The text continues, "It probably won't surprise you that humans are the cause of this massive destruction of life." (p. 128)

Some balance is provided by informing students that killing animals might be the only source of income for some populations. Students are asked to consider how they would feel if a law that protects endangered species took away their livelihood. (p. 129) Unfortunately, the text fails to mention that using economic incentives, allowing the native population to benefit from the animals, would encourage preservation of the herds.

World Regions, published by Macmillan/McGraw Hill, points out that the need for additional farmland for native populations in Kenya conflicts with the policy of locking land in preserves for animals. Again, no mention is made of how economic incentives can be used to protect animals when native populations are permitted to benefit from animal preservation. (p. 456)

Managing Our Natural Resources, Delmar Publications, suggests a different view of conservation and preservation issues. "Conservation brings to mind sentimental thoughts of nature and beauty, but the true test for conservation is whether society benefits from its undertakings." As to preservation, the authors suggest that "we must balance our desire for preservation with our needs as a people." (p. 27)

Unlike the vast majority of texts, *Managing Our Natural Resources*, also explains that managing resources held in common is difficult because while they are theoretically owned by everyone, in reality they are owned by no one. "No one owns them but everybody can use them. Everybody pays for them, but the amount that any one pays is not related to how he or she takes care of them." The authors use the example of marine fisheries, explaining that since the fish are held in common "it pays the fisherman to take as many fish as possible." But that decision, while rational under the circumstances, "would lead to the destruction of the fish population." The text continues,

> Whether resources are owned privately or not has major implications for management. ... For example, a farmer has jurisdiction over his or her soil, but does not own the wildlife that comes onto the property. The wildlife is "owned" by all Americans. ... This distinction has obvious impacts on management options. Our system could be contrasted to the European system in which the landowner owns the wildlife on his or her own property. (pp. 310-11)

This text also differs from most in that it frames the problems and solutions of resource management in terms "of utility" to the human population.

> As a society, we make decisions — including natural resources management decisions — based on the benefit to the members of the society. These decisions should take into account an understanding of our history, ecology, economics, and social values. They must also take into account world, national, state and local politics. There are many conflicting pressures and influences on our decision-making process. In the final analysis there are no BEST or RIGHT answers to natural resources management questions. But there are lots of WRONG answers. Wrong answers are those that do not provide for the long-term benefit of humanity. (p. 312)

This treatment is in contrast to the critical attitude toward humans and the idealized concept of nature for nature's sake found in most texts.

This text also mentions the role of private associations in preserving wildlife. "Without serious argument, all must agree that the large and healthy game animal, bird, and fish populations in the United States are a result of conservationist efforts. And those efforts have been led and funded over the last century by hunters and fishermen." (p. 11)

Biology: An Everyday Experience, published by Glencoe, does not mention the drawbacks of the expanded Endangered Species Act. Rather the Act is presented as an unqualified good.

> In 1973, the United States Congress passed the Endangered Species Act. This law states that anyone found guilty of killing, capturing, or removing any endangered species from its environment, can be fined up to $20,000 and jailed for one year. The law also protects the habitat of any endangered species. In order for government refuges and laws to work, everyone must cooperate. This means that everyone must obey the law and make every effort not to reduce our wildlife populations. (p. 687)

By omitting the harm done endangered species when private owners are forced to destroy habitat to protect their investment, students will have an incomplete understanding of the problems created by some regulatory measures.

In summary, the majority of the texts cite high numbers for species extinction and place the blame on human beings. For the most part, regulatory solutions are favored and, with one exception, the way in which economic incentives might be harnessed to preserve species is ignored.

ENERGY AND NATURAL RESOURCES

Introduction

The topics of energy and natural resources are intertwined with complex economic issues which should be part of any balanced environmental education course. Debates about energy and natural resources usually turn on opposing views of allocation, distribution, and conservation. Some argue that national security and economic survival demand that government make sure the country has a stable supply. In this view, energy and resource use are too important to leave to market forces. Instead, government, guided by concern for the environment, must make sure that resource and energy policies are in the best interests of the entire society, not just resource producers and consumers.

The alternative approach is that allowing the free market to work is the best way to decide natural resource issues. Advocates of this approach note that while the market has limitations, history shows that government policies in these areas have failed miserably. Markets stimulate conservation by responding to shortages with higher prices, encouraging discovery of substitutes and spurring innovation to create new products. To be fully informed, students should understand both sides of this important issue.

The Need for Government-Based Resource Production and Allocation

Proponents of this view believe we are facing impending shortages of natural resources and energy supplies. They blame population growth, coupled with excessive consumption, for consuming these resources at an accelerating rate. Advocates of government management of resources and energy supplies propose price controls, regulations, and environmental protections as the only means of protecting the environment from careless exploitation and making sure of adequate supplies for the future. The basis for these recommendations is that once these resources are exhausted they are gone forever. At present consumption rates, known reserves of resources, those that are recoverable at present prices, will not be sufficient for future use. Government limitations on resource use, thus, is the only way to assure that future generations will have the energy and resources they need.

Advocates of government management often point to a laundry list of environmental disorders resulting from the technology that is consuming our resources. They argue that government must regulate resource and energy use to protect the environment. A frequently used argument is that resources are not distributed equally in the world and industrialized nations are consuming more than their fair share. Advocates of resource and energy

management by government are critical of resource consumption in the United States and other industrialized nations. They make the point that although the U.S. has only about 5% of the world's population, it uses about 60% of the world's natural resources. An international energy policy has been proposed to assure conservation, protect the environment, and equitably distribute remaining supplies.[22]

The Need for Market-Based Resource Production and Allocation

Advocates of letting the market dictate energy and resource production and allocation agree that resources are finite, but argue that the fact is irrelevant. They point out that people want the services that resources provide, not the resources themselves because without human ingenuity to use them, resources alone have no value. History shows that human beings shift from scarce resources to more abundant ones to obtain the services they need. Market management means that when demand for a resource exceeds supply, the price of the resource will increase, spurring producers to find new sources — increasing known reserves — and motivating inventors to find new ways to deliver resource-based services. Letting the price mechanism operate, they argue, spurs both technological progress and more efficient use because competition forces producers to reduce production waste and lower costs.[23]

They point to markets as the real measure of resource and energy supplies. If the world were truly running out, they argue, energy and resource prices would be high. Instead, between 1980 and 1990 energy prices fell by 25%, coal and oil by 47% and 35% respectively, and metals and minerals by 31% when adjusted for inflation.[24]

Market advocates also dispute criticism of industrialized nations for consuming too many resources. They point out that the productivity and efficiency of the Western world has greatly benefited poorer countries. According to this view, resource depletion is not a problem as long as there are markets to distribute information and products, and free, creative human beings to use them.

Criteria for Energy and Natural Resource Issues

To determine whether a balanced presentation of the two ways of looking at these issues is provided, we have rated the texts using the following key criteria to the right.

Discussion

Textbook treatment of natural resource and energy issues is mixed. Most texts present a more balanced presentation of these topics than of other environmental issues. Even so, the outlook is usually pessimistic.

Physical Science: Challenge of Discovery, published by D.C. Heath, appears to want students to feel guilty about the way Americans live.

> Today people are more aware that fossil fuels are nonrenewable and limited in supply. Unfortunately, global use of fossil fuels has not decreased. In the United States, fuel is wasted and used carelessly. The United

EXPLAINS THE ARGUMENTS FOR GOVERNMENT-BASED RESOURCE REGULATION AND ALLOCATION

Government action is necessary to prevent shortages	
Explains Fully	5
Inadequate Explanation	5
Incorrect Explanation	0
Not Mentioned	10
Overpopulation will cause all resources to be used up	
Explains Fully	9
Inadequate Explanation	5
Incorrect Explanation	0
Not Mentioned	6
Need government regulations to protect the environment	
Explains Fully	4
Inadequate Explanation	4
Incorrect Explanation	0
Not Mentioned	12

EXPLAINS THE ARGUMENTS FOR MARKET-BASED RESOURCE PRODUCTION AND ALLOCATION

Resources are not scarce — prices are falling or level	
Explains Fully	1
Inadequate Explanation	1
Incorrect Explanation	0
Not Mentioned	18
Price increases cause conservation, increased exploration, shift to alternatives, and the invention of new ways of providing the same service	
Explains Fully	3
Inadequate Explanation	5
Incorrect Explanation	0
Not Mentioned	12

> States has 6 percent of the world's population but uses 35 percent of the energy available in the world. For example, the number of electric appliances used in this country is greater than in many other countries throughout the world. Heated swimming pools and hot tubs are seen as necessities in some parts of the United States. This is not true in other countries. Third World countries such as Ethiopia, Bangladesh, and El Salvador, for example, are economically disadvantaged and have little or no industry or technology. As these countries try to improve the standard of living for their citizens and become industrialized, they need more energy, not less. (p. 616)

While making the case for fuel conservation, the text suggests, "Conservation does not necessarily mean a drastic change in your life-style. You just need to identify areas where you are simply careless or wasteful of energy." (p. 616) The authors clearly categorize many consumer items and energy uses as wasteful, although what conveniences should be eliminated is not stated. Students are told, "In purchasing an appliance, people should consider whether or not the appliance is essential." (p. 618) In any case, the message is clear: the United States is guilty of living too well and needs to reduce its energy use for the sake of developing nations.

Biology: An Everyday Experience, published by Glencoe, not only predicts a depressing future, but openly endorses government allocation and regulation theory.

> Americans use fossil fuels for about 89 percent of our energy needs. As the human population continues to grow, more energy is needed to run larger cities and more cars, homes and factories. The supply of fossil fuels is being used up at an alarming rate. When coal, oil and natural gas supplies are gone, there will be no more. More energy sources must be found. Governments must help save our fossil fuel supply by passing laws limiting their use. (p. 677)

World Geography Today, published by Holt, provides a pessimistic view of resource availability. "Petroleum is a nonrenewable resource. The world's supply may last only another 50 years or so." (p. 616) However, the authors do not ignore the role of technology in providing for people's needs, even as they raise questions about the use of resources and the future.

> Many people are optimistic about the future. As the earth's population increases, they believe, scientists will discover ways to produce new kinds of foods. Farmers will increase crop yields through new methods, more food and water will be taken from the sea, and high-rise buildings will permit more people to live in less space. Yet others wonder whether answers to continued population growth can be found. They ask if we have not reached the point at which important resources are already in short supply. Will substitutes be found for many ... dwindling natural resources ? Can we continue to pollute the environment without harming our planet, our nation, and ourselves? Will countries continue to trade valuable natural resources? Will the richer nations share their wealth and resources with the less fortunate nations? (p. 620)

World Geography: The Earth and Its People, published by Harcourt Brace Jovanovich, present a more optimistic view by elaborating on the way technology greatly affects our use of resources. "Technological change also creates uses for previously unvalued natural materials. In the 1700s, people did not use uranium ores and did not value them as natural resources. Uranium ores gained value only after modern advances made them useful as a resource for nuclear energy." It is also one of the few texts to explain the impact of market forces on resource consumption and conservation.

> Scarcity and rising prices have always led people to seek cheaper substitutes for costly resources. In colonial days, for example, people burned whale oil for lighting. As demand for whale oil rose more and more whales were hunted. Eventually overhunting made the whales harder to find and prices rose. People then looked for cheaper substitutes. In time they found a way to make kerosene from petroleum. Because kerosene cost less than whale oil, it quickly replaced whale oil as a lighting fuel. (p. 108)

Life Science, published by Macmillan, also explains technology's role in helping to meet the needs of a growing human population. "Technology as you have seen, is helping make farms more productive. ... Technology, however, is helping people locate more supplies of coal and oil. ... Technology is also making it possible to use other sources of energy." (pp. 482-83)

Only two texts mention that resource prices have been falling, indicating that scarcity is not a pressing danger. All the facts should be presented in an unbiased way if students are to have a full understanding of resource and energy issues.

GLOBAL WARMING

Introduction

Many texts have something to say about global warming. This is an important issue because it directly relates to our lifestyles in modern industrial societies. While some scientists predict catastrophe, others are more sanguine, basing their analysis on actual recorded temperature changes. Students need to be apprised of both sides of this important scientific debate.

Greenhouse Effect

Scientists agree that the "greenhouse effect" keeps the Earth's temperature at a livable level. This occurs because water vapor, carbon dioxide, methane, and other greenhouse gases keep the Earth warm by trapping infrared rays that would otherwise be reflected into space.

This warming effect is called the "greenhouse effect" because it is similar to the buildup of heat that occurs in greenhouses. However, it is not actually the same. Most of the warming in a greenhouse occurs because air is warmed and then trapped by the glass or plastic walls. Global greenhouse gases trap not air, but infrared rays of sunlight, which are re-radiated from the Earth's surface. Most scientists believe that thanks to the greenhouse effect, the Earth is about 33 degrees Celsius (59.4 degrees Fahrenheit) warmer than it would otherwise be, thus making it livable. Most scientists agree on these facts.[25]

Most scientists also agree that the level of carbon dioxide (CO_2) and other greenhouse gases in the atmosphere has increased. The level of CO_2 is 27% higher today than it was 200 years ago, but it is still a very small part of total atmospheric gases — .035%. In addition, there has been a slight warming of the Earth's average global temperature over the last 100 years. While the exact amount of this warming is under dispute, most scientists agree that it is at most one degree Celsius.[26]

Where scientists disagree are the cause and effect relationships between the increase in greenhouse gases and the change in temperature. One group of scientists subscribe to the "global warming theory." Those who disagree say the actual temperature record does not support this theory. This latter group of scientists criticize this theory.

The Global Warming Theory

The theory that the Earth is getting warmer is based on the increase of greenhouse gases in the atmosphere. Since carbon dioxide is released when fossil fuels such as coal and oil are burned, and when forests are cut and not replanted, the amount of carbon dioxide in the atmosphere has been going up since the start of the Industrial Revolution about 200 years ago. It has risen most rapidly since the Second World War.

Since the factors which influence the Earth's climate are numerous and the ways they interact are very complicated, scientists seeking a better understanding use sophisticated computer models to represent reality. These models are based on large amounts of data about climate and weather. Complex formulas simulate the Earth's climate and provide the basis for predictions of the changes which might occur due to higher levels of greenhouse gases. Scientists who use these models predict that the increase in carbon dioxide and other greenhouse gases in the atmosphere is causing global temperatures to rise. These scientists predict that by the year 2040, the Earth will have warmed by two degrees Celsius and by the year 2100, the Earth will have warmed by five degrees Celsius. Some scientists believe that the hot summers in the late 1980s demonstrate that the warming has already begun. In 1988, James Hansen, a well-known climatologist, told a congressional committee that he thought the greenhouse effect had begun to raise global temperatures.[27]

Furthermore, these scientists use their computer models to predict what effects global warming will have on the Earth's climate, weather, and environment. According to these scientists, global warming will produce a host of worldwide catastrophes. Warming will melt the polar ice caps, causing them to recede and in turn raise the level of the Earth's oceans. Predictions differ but there is some scientific consensus that the oceans will rise about 80 centimeters (31.5 inches). This may not seem like much, but it will cause major and permanent ocean flooding in the coastal cities of the world.

The computer models also predict catastrophic changes in the Earth's climate. The temperature increase will produce droughts in major food-producing areas of the world causing global food production to fall. In other areas, more rain will fall, producing increases in the insect population and these hungry insects will eat up crops. The temperature rise will drastically alter weather patterns, producing more and stronger hurricanes and tornadoes.

To avert these catastrophes, immediate steps to reduce greenhouse gases are necessary. Scientists argue that by the time we see actual increases in global temperatures, it will be too late. If efforts to reduce greenhouse gases are delayed, they will have little effect on the warming which has taken decades to create. Therefore, they argue, we must start now to reduce the amount of greenhouse gases.

Critics of the Global Warming Theory

Scientists critical of global warming theory base their assessments on the Earth's actual temperature record. The data contradict the global warming theory. The pattern of warming does not parallel the rise of CO_2 in the atmosphere, as would be the case if the global warming theory were true. Although CO_2 concentrations in the atmosphere rose dramatically after World War II, the record shows that most of the temperature rise during the last 100 years occurred before 1938, when levels of CO_2 were lower than after the war. If the increase in carbon dioxide was causing warming, global temperatures would continue to rise and accelerate after World War II just as the carbon dioxide levels did after World War II.[28]

A second reason to be skeptical of global warming theory is that the complex mathematical formulas fed into the computer do not include all the factors that influence climate. For example, the models give such a rough picture of the Earth's climate that they miss entirely the effect of mountains such as the Sierra Nevadas and the Cascades. According to these models, the climate of heavily forested and rainy coastal Oregon and the climate of the inland Nevada desert would be about the same.[29]

These scientists also point out that predictions of climate change are highly speculative. They note that in the mid-1970s, some scientists analyzed the temperature record of the Earth and concluded that a new ice age was coming.

Other questions about global warming theory are raised by the influence of water vapor on the greenhouse effect. Water vapor is far more important than carbon dioxide in trapping heat, and temperatures very much depend on whether water vapor will increase or decrease if the carbon dioxide level rises. No one is sure. Clouds (composed of water vapor that has condensed into droplets) also may increase if carbon dioxide goes up. Some clouds increase the warming effect and others decrease it by reflecting sunlight back into space, cooling the Earth.[30]

Then there are the oceans, which absorb carbon dioxide. But how much? The speed with which they absorb and release CO_2 will influence the amount of carbon dioxide in the atmosphere, but no one is sure about how long CO_2 remains in the oceans.

The consequences of slight warming also are uncertain. The record of temperatures in the Northern Hemisphere shows that daytime temperatures have increased only slightly compared to nighttime temperatures. Warmer nights would mean longer growing seasons and less severe winters.[31] It is also true that warmer temperatures create more clouds — which would mean an increase in rainfall, reducing the likelihood of drought. Laboratory and field experiments have demonstrated that CO_2 almost always enhances plant growth and increases

crop yields. Instead of global warming theorists' famines, the result could be more plentiful harvests.[32] These scientists point out that there are just too many uncertainties and unanswered questions to act precipitously.

Global Warming Criteria

To determine whether textbook coverage of global warming presents the current state of scientific knowledge in a balanced and objective manner, we rated the list of key points to the right.

Discussion

As the chart indicates, most texts did a good job of explaining how carbon dioxide and other gases trap the Sun's radiation, which warms the Earth. Also clear in most texts is that the level of carbon dioxide and other greenhouse gases in the atmosphere has increased, and that some warming has occurred. There is general agreement within the scientific community about these facts and they are covered in varying degrees of detail in the books I reviewed.

However, I also found that the vast majority of textbooks emphasize global warming theory. All the texts I reviewed explained global warming theory, often in considerable detail. All but one text cites the catastrophes predicted by global warming theorists.

EXPLAINS THE SCIENCE OF THE "GREENHOUSE EFFECT"

Carbon dioxide and other greenhouse gases trap the Sun's radiation, which warms the Earth	
Explains Fully	21
Inadequate Explanation	3
Incorrect Explanation	0
Not Mentioned	0
Carbon dioxide and other greenhouse gases have increased in the atmosphere	
Explains Fully	19
Inadequate Explanation	5
Incorrect Explanation	0
Not Mentioned	0
There has been slight warming over the last 100 years	
Explains Fully	8
Inadequate Explanation	8
Incorrect Explanation	0
Not Mentioned	8

EXPLAINS THE GLOBAL WARMING THEORY

This theory is based on computer models	
Explains Fully	4
Inadequate Explanation	0
Incorrect Explanation	0
Not Mentioned	20
Carbon dioxide is "causing" global warming	
Explains Fully	20
Inadequate Explanation	4
Incorrect Explanation	0
Not Mentioned	0
This warming will produce harmful changes in the climate and weather	
Explains Fully	15
Inadequate Explanation	8
Incorrect Explanation	0
Not Mentioned	1
The problem requires government action to reduce burning fossil fuels	
Explains Fully	8
Inadequate Explanation	5
Incorrect Explanation	0
Not Mentioned	11

EXPLAINS THE ARGUMENTS OF THE CRITICS OF THE GLOBAL WARMING THEORY

Explains the weaknesses of the computer models	
Explains Fully	2
Inadequate Explanation	1
Incorrect Explanation	0
Not Mentioned	21
Warming prior to 1938 — CO_2 buildup since 1938	
Explains Fully	0
Inadequate Explanation	0
Incorrect Explanation	1
Not Mentioned	23
Role of water vapor, including clouds in regulating Earth's temperature	
Explains Fully	2
Inadequate Explanation	3
Incorrect Explanation	0
Not Mentioned	19
Some warming may be beneficial	
Explains Fully	1
Inadequate Explanation	2
Incorrect Explanation	0
Not Mentioned	23

Most texts explain, some more adequately than others, that to avert these catastrophes, immediate steps to reduce greenhouse gases are necessary. A little more than half of the texts suggest government action to reduce the production of greenhouse gases. All texts state that the theory that the Earth is getting warmer is based on the increase of greenhouse gases in the atmosphere. All the texts I reviewed cover warming and its consequences, although only a few explain the computer models on which the theory is based.

The opposing view does not fare as well. The vast majority of texts provide little information about the work of scientists who do not agree with global warming theory. Since most texts do not even mention the computer models which predict warming and its catastrophic results, most do not explain the weaknesses of these

models as predictive instruments. Most students are not told that the complex mathematical formulas fed into the computers do not include all the factors that influence climate.

Most texts either make no mention of the role of water vapor and clouds in regulating the Earth's temperature or provide a sketchy explanation. No text mentions that the pattern of warming causing so much concern does not parallel the rise of CO_2 in the atmosphere, as would be the case if global warming theory were certain.

No text mentions that opposing scientists base their assessments on the Earth's actual temperature record and that these data contradict global warming theory. Only one text includes possible beneficial aspects of global warming, should it take place. A balanced presentation would inform students about both sides of this important scientific debate. As the preceding chart and discussion indicate, such is not the case.

The textbooks used in Wisconsin emphasize the theory of global warming at the expense of opposing views. For example, *Earth Science*, published by Scott Foresman, leads students to conclude that global warming is an established fact.

> Presently, enough carbon dioxide has been added to the atmosphere to raise the average global temperature 2° C to 5° C within the next few decades. Scientists have determined that changes of this size would change patterns of rainfall and climate. Rainfall in most of the United States would decrease, and agriculture would be affected. (p. 354)

Physical Science, published by Prentice Hall, offers a more balanced presentation of global warming than is usually the case. Students are informed of the hypothetical nature of global warming theory. "By using laboratory simulations and computer generated graphs and charts, researchers have come up with this hypothesis: The average worldwide surface temperature could increase from 1.5 to 5.5 Celsius degrees by the year 2100." Melting polar ice caps and coastal flooding, droughts, drinking water poisoned by sea salts, and other catastrophes are listed.

> Other researchers refuse to be so pessimistic. Recent studies by scientists at the American Geophysical Union Conference suggest that carbon dioxide buildup in the atmosphere might be only half as great as has been projected. There is evidence that the oceans could absorb a large amount of carbon dioxide produced by burning fossil fuels. Another cause for optimism is the discovery that an increase in atmospheric carbon dioxide causes clouds to become wetter and denser. These denser clouds reflect more sunlight than they let through. This fact suggests that ultimately there would be less heat for the atmosphere to trap and less heat to warm the globe. Some scientists even theorize that the earth may even become cooler! There is debate over the need for immediate action. As John Hoffman of the Environmental Protection Agency proclaims, "We feel carbon dioxide is a very serious thing, but we think there is time to do research, and there is time to adapt." But others worry that time is running out and regulatory action to protect the environment must be taken now. (p. 437)

Physical Science: Challenge of Discovery, published by D.C. Heath, is one of the few texts that mentions the weaknesses of computer modeling. "The computer models that scientists use to predict climate patterns are not precise enough to take all the complicated weather factors into account. In addition, scientists do not yet understand the impact of many natural processes on weather." However, the authors endorse global warming theory. "In spite of this uncertainty, however, most scientists think that greenhouse gases will make Earth warmer, possibly quite rapidly. Global warming probably cannot be avoided totally, but it can be slowed down by limiting the release of these gases." The text concludes by suggesting, "Greenhouse warming is a worldwide problem, and richer, more industrialized nations may have to assume much of the cost of correcting it." Under a section called "Take Action" students are advised to contact groups (Sierra Club, Worldwatch Institute) that subscribe to the global warming theory. "Write to one of them and ask what actions they suggest to take on this issue." (p. 585)

Biosphere: The Realm of Life, published by Scott Foresman, does not question greenhouse theory. Although admitting that "[s]o far, the actual effect seems to have been minor, hypothetically, because of geophysical changes that would normally have resulted in a cooling of the earth." The text assures students: "Still,

according to the experts, the temperature cycle will eventually reverse, and when it does, the greenhouse effect will be accelerated." The authors then summarize the dire consequences predicted by "the experts." (p 719).

Teen Health, published by Glencoe, also presents global warming theory as a scientific certainty.

> By putting more carbon dioxide in the air, pollution may make the world warmer. The carbon dioxide acts as a blanket that keeps warmth near the earth. If this goes on, some scientists believe, some of the ice in the north and south poles may melt. This new water will cause the oceans to rise, which may cause some coastal cities to become flooded. The rise in temperatures may also make crops grow less well. (p. 431)

The use of words such as "some scientists believe" and "may" provide a pretense of balance, but without explaining what "other scientists" base their assessments on students receive an incomplete explanation.

Health, published by Holt, asserts global warming theory as fact.

> Already, global warming has resulted in a rising sea level and the erosion of many coastal areas. Experts believe that by the year 2100, increasing temperatures could melt many glaciers and raise the sea level another two to seven feet. A seven foot rise of sea level would flood 50 to 80 percent of our coastal wetland (bays and swamps) and cause extensive destruction of coastal property, wildlife and beaches. (p. 548)

World Geography Today, published by Holt, is another text that presents global warming theory as fact. "Two ways to protect ourselves from a continued heat build-up are to cut back on the burning of fossil fuels and to stop cutting tropical rain forests." (p.616)

Health: A Guide To Wellness, published by Glencoe, is more balanced than most texts, although its treatment of the topic is limited: "There are as many opinions on the results of the greenhouse effect as there are scientists studying it. One view is that the earth will get increasingly warmer. Other scientists predict that the results will be more complex and that some parts of the world might even get cooler." (p. 600)

Biology: Living Systems, published by Merrill, is one of the few texts to indicate that the evidence on global warming is not conclusive.

> Burning of fossil fuels may have a long-range effect on average global temperatures. The amount of CO_2 in the atmosphere has increased greatly with the burning of fossil fuels in industry and transportation. Increase of CO_2 in the atmosphere may cause some of the heat leaving the Earth to be radiated back to the surface. Thus some people feel that an increase of CO_2 in the environment may have an overall warming effect. ... Other scientists feel that the increasing number of all particles in the air from pollution may have an opposite effect. They suggest that more sunlight will be reflected back into space before it reaches the Earth's surface. This reflection could lead to a decline in temperatures on Earth. (p. 745)

Biology, published by Prentice Hall, makes little attempt at balance.

> As levels of carbon dioxide in the air increase, however, more heat is absorbed, and the temperature of the Earth increases. The effects of global warming, which is occurring slowly at present, are unclear. Some scientists believe that if a global warming of even a few degrees occurs, it will cause polar ice caps to melt. This will release enough water to raise sea levels and flood many coastal areas. A warming of the Earth's climate — by even a few degrees — will also cause major changes in human agriculture to occur. (p. 1058)

Just informing students that the effects of global warming are unclear is not enough to balance the treatment of the topic. Students need to be aware of the conflicting evidence and the complexity of the issue.

Earth Science, published by Prentice Hall, seems to support catastrophe no matter what, telling students that both warming and a new ice age are possible results of the increase in greenhouse gases. (p. 314)

Based on these findings, I conclude that Wisconsin's students receive a one-sided exposition of the

complex issues of global warming. Frightening scenarios of future catastrophes emphasize the point that drastic alterations in modern lifestyles are necessary to save the planet. Much blame is placed on industrialized societies for wreaking havoc on the environment, but the gains in living standards, health, and longevity are not given the same emphasis. A more balanced exposition would inform students of both sides of the global warming debate and motivate them to consider a wide range of possible answers and solutions.

OZONE DEPLETION

Introduction

Possible thinning of the Earth's stratospheric ozone layer is a major environmental concern. An acceptable environmental education program should include information about what ozone is, how it is formed, and the uncertainties about it which cause the scientific community to be divided on this issue.

Ozone Facts

Ozone is a gas composed of three atoms of oxygen (0_3). Normal oxygen which we breathe is composed of two atoms of oxygen (0_2). Ozone is found in small quantities high in the Earth's atmosphere. Scientists know that ozone absorbs harmful ultra violet rays (UV) that would otherwise reach Earth. Because natural ozone fluctuations are so great, it is difficult for scientists to prove conclusively whether ozone is declining. Ozone is constantly being created, breaking apart, and being created again. Winds concentrate it in the higher latitudes so there is less near the equator. As a result, the amount of ultra violet rays that reach the Earth differs — depending upon distance from the equator and altitude, with mountain tops getting more than low lying areas and equatorial areas getting more than higher latitudes.

The Ozone Depletion Thesis

Proponents of the ozone depletion theory believe ozone is disappearing from the upper atmosphere and stratosphere, causing an increase in harmful UV radiation. They believe the problem is serious and that ozone is thinning, putting people at greater risk for skin cancer, eye diseases, and birth defects. They also predict that loss of ozone will disrupt growing cycles and weather patterns, producing harmful results for the planet and the people on it.

Ozone is a relatively unstable molecule that can break apart to form oxygen and a free-floating oxygen atom. The term ozone depletion describes that process. According to the findings of a 1988 panel of scientists convened by the National Aeronautics and Space Administration (NASA), ozone levels above the Northern Hemisphere declined, depending on latitude, between 1.7% and 3% between 1969 and 1986.[33] Concern about ozone depletion was intensified when scientists discovered an "ozone hole" over Antarctica. Data indicate that between August and October of 1984, the amount of ozone over Antarctica dropped more than 40% below what records show it was in 1977.

Ozone depletion theorists blame man-made products, especially chlorofluorocarbons (CFCs) for destroying ozone. CFCs provide cooling for air conditioners and refrigerators and, because they are non-toxic and non-flammable, CFCs are widely used by industry. Ozone depletion occurs when the chlorine atoms in CFCs float up to the stratosphere and are broken apart by sunlight, releasing the chlorine atoms. Through complex chemistry, chlorine atoms can combine with ozone molecules, changing ozone to oxygen and causing ozone depletion. Citing evidence of ozone thinning, some scientists say that although the effects may not be obvious for many years, we can't safely wait for the effects to become obvious before taking action. By that time, they warn, it will be too late to remedy the damage. Accordingly, they propose that we stop using CFCs now and switch to substitutes even if that entails some lifestyle sacrifices and increased expense.[34]

Critics of the Ozone Depletion Thesis

Critics find a number of weaknesses in the ozone depletion theory. They argue that the magnitude of natural ozone variation makes it nearly impossible to calculate the man-made influences on ozone. The thickness of the ozone layer can vary as much as 50% from season to season and place to place on the globe.[35] The thinning of the ozone layer over Antarctica, the much publicized "ozone hole" actually occurs naturally every spring due to a circular wind pattern called the Antarctic vortex that naturally forms around the Antarctic continent during the winter. Since warmer air from the tropics cannot break through this vortex, the air temperature inside becomes very cold and ice clouds can form. When the Sun is again visible in early spring, a chemical reaction involving ozone, chlorine, and other chemicals is triggered — depleting ozone inside the vortex. As the season progresses, the vortex breaks up and the ozone layer is naturally replenished with a fresh supply from the tropics. This so called hole has varied in size and depth over the years. Why this happens is not fully understood, nor is it known what role CFCs may play in ozone variation. The chlorine that causes ozone depletion may come from CFCs — but other factors, such as unusually cold stratospheric temperatures, may be far more important contributors to the hole. Critics argue that over the period of a few months, the amount of ozone over some areas of the United States can vary naturally by as much as 50%. They point out that the variation reported by the NASA panel also may be explained by an 11-year sunspot cycle.[36] They also suggest a linkage between ozone and ocean temperatures. Warmer ocean temperatures are linked to ozone decline, while cooler temperatures increase ozone.[37]

Skeptics point out that researchers have found minimal impact from ozone depletion on the plants and animals in the Antarctic region.[38] They also say that if ozone is really decreasing, scientists should find a measurable increase in UV radiation on the Earth's surface. That such an increase has not been found further weakens the case that serious ozone depletion is under way.[39] Critics also point out that if the ozone above the United States had thinned by 4% or 5%, as estimated by the Environmental Protection Agency, the actual effect would be about the same as moving from Seattle to Tacoma.[40] They recommend continued study of ozone and putting what is known into perspective rather than using it to frighten or to encourage precipitous action. Similarly, they suggest that the costs and hazards as well as the possible benefits of discontinuing CFCs be made known to the public.

Ozone Depletion Criteria

To gauge how well the textbooks explain the facts about ozone, the ozone depletion theory, and the arguments challenging that theory, I developed the list of key points on the next page and rated the texts as to how well each was covered.

Discussion

The chart shows that the texts provide an uneven explanation of ozone facts, generally ignoring natural ozone variability in favor of an alarmist picture of human-caused thinning. This is consistent with detailed explanations of the ozone depletion thesis, compared to lack of explanations of opposing arguments.

Biology, published by Prentice Hall, offers little elaboration of ozone depletion, but what the text does say is misleading. "Scientists have recently discovered that the ozone layer is becoming thinner in certain places around the globe — a phenomenon they call holes in the ozone layer." The text explains that these are not really holes, but thin spots caused by "chemical air pollution that results primarily from the addition of chlorofluorocarbons in the air." No mention is made of natural variability or the difficulty of determining the influence of man-made chemicals. (p. 1059)

Life Science, published by Harcourt Brace Jovanovich, tells students, "Many scientists believe that the use of chlorofluorocarbons is the major cause" of ozone depletion. The authors ask, "What can be done to stop the loss of atmospheric ozone?" The text provides what it calls "the most obvious answer" which "is to severely limit or hold CFC use at its present level." Although the authors use the caption of an illustration to inform students that "[t]he size of the hole in the ozone layer changes with the seasons from year to year," that variability is not

EXPLAINS OZONE FACTS

Ozone is an unstable molecule of three atoms of oxygen

Explains Fully	4
Inadequate Explanation	15
Incorrect Explanation	0
Not Mentioned	8

The ozone layer is a thin layer of molecules in the stratosphere

Explains Fully	17
Inadequate Explanation	10
Incorrect Explanation	0
Not Mentioned	0

Ozone is constantly being created and destroyed in the atmosphere

Explains Fully	0
Inadequate Explanation	2
Incorrect Explanation	0
Not Mentioned	25

Ozone absorbs harmful UV rays

Explains Fully	23
Inadequate Explanation	4
Incorrect Explanation	0
Not Mentioned	0

EXPLAINS THE OZONE DEPLETION THESIS

The ozone layer is being destroyed by CFCs and other man-made products

Explains Fully	21
Inadequate Explanation	5
Incorrect Explanation	0
Not Mentioned	1

The ozone hole over Antarctica is an indicator of the danger

Explains Fully	14
Inadequate Explanation	2
Incorrect Explanation	0
Not Mentioned	11

If ozone layer is destroyed or thinned, will increase skin cancer, etc.

Explains Fully	19
Inadequate Explanation	4
Incorrect Explanation	0
Not Mentioned	4

Danger is so great that governments must take action to abolish CFCs

Explains Fully	13
Inadequate Explanation	6
Incorrect Explanation	0
Not Mentioned	8

EXPLAINS THE ARGUMENTS OF THE CRITICS OF THE OZONE DEPLETION THESIS

Ozone is highly variable, so it is hard to determine if man is influencing it

Explains Fully	0
Inadequate Explanation	0
Incorrect Explanation	0
Not Mentioned	27

Ozone changes may be linked to sunspot cycles, not man-made products

Explains Fully	0
Inadequate Explanation	1
Incorrect Explanation	0
Not Mentioned	26

The so-called ozone hole over Antarctica produced little or no harm to the environment

Explains Fully	0
Inadequate Explanation	0
Incorrect Explanation	0
Not Mentioned	27

Increases in UV radiation reaching the Earth have not been measured

Explains Fully	0
Inadequate Explanation	0
Incorrect Explanation	1
Not Mentioned	26

The predicted increases in UV are so small as to equal the increase experienced by moving 60 miles north or moving to a city in the mountains

Explains Fully	0
Inadequate Explanation	0
Incorrect Explanation	0
Not Mentioned	27

explained, nor are the difficulties it represents for accurately measuring the extent of ozone loss." (p. 472)

Biosphere: The Realm of Life, published by Scott Foresman, does not mention the seasonal variability of the ozone layer or the problems involved in determining man-caused changes. The authors cite the National Academy of Sciences' estimate that "each 1% decrease in ozone can be translated into 12,000 to 30,000 new skin cancers in the United States alone." The text describes the "gigantic ozone hole" developed above Antarctica and tells students:

> The scientific world was greatly concerned about the potential worldwide effects of any atmospheric change of this proportion. ... The scientists suspect that the chlorofluorocarbons are responsible but they admit they know little about such atmospheric chemistry. In fact, the development over Antarctica was a complete surprise. Many are concerned that yet other surprises are in store. (p. 765)

Perspectives on Health, published by D.C. Heath, is certain that CFCs are damaging the ozone layer.

> Scientists later discovered that when CFCs are used they do not simply disappear. Instead, they rise up to the lower level of the ozone layer, interact with sunlight and destroy the ozone layer. The thinning of the ozone layer allows more UV rays to reach the earth's surface. Scientists have estimated that as much as seven percent of the ozone layer has been destroyed since CFCs were developed. (p. 646)

Students would not know that the role CFCs may play in ozone variation is not certain and not well understood or that the chlorine that causes ozone depletion may come from CFCs, but other factors, such as unusually cold stratospheric temperatures, may be more important.

Health: Skills for Wellness, published by Prentice Hall, is another text that presents ozone depletion and the culpability of CFCs as established scientific facts. "CFCs are serious air pollutants because they destroy the ozone layer, a region of the atmosphere with a high concentration of ozone." The authors explain that ozone depletion lets more ultraviolet light penetrate the Earth's atmosphere. "Scientists are concerned that increasing levels of ultraviolet radiation will damage plants, reducing food supplies on land and in oceans as well. Since CFCs are destroying the ozone layer, more ultraviolet light than ever before is reaching Earth's surface." (p. 606)

Health: A Guide To Wellness, published by Glencoe, makes a weak attempt at balance. Although the text states, "The causes of ozone depletion are being debated in the scientific community," there is little debate in the textbook's presentation of the role of CFCs. "To be sure, large volcanic eruptions, such as the recent eruptions of Mount Penatubo in the Philippines, and cyclical changes in solar activity have serious effects. However, the major factor in ozone reduction is chlorofluorocarbons (CFCs), which are compounds of chlorine, fluorine and carbon." (p. 599)

As these examples and the chart indicate, treatment of ozone depletion is not only disappointingly one-sided, but most explanations of the scientific facts about ozone are incomplete. As a result, students will not understand the natural factors that cause variation and some will even conclude that there are real holes. All the authors appear to accept the ozone depletion thesis unquestioningly. Unfortunately, since the information in the texts is so limited, students have no choice but to also believe it.

POPULATION AND FOOD ISSUES

Introduction

World population growth is one of the major environmental issues which students should understand in order to be environmentally literate. Fear that the expanding human population will create ecological disasters is based on a variation of the economic theories of Thomas Malthus. Malthus, writing in 1798, reasoned that since food increases arithmetically and population increases geometrically, world population would soon outstrip the food supply and mass starvation would result.

Other economists, then and now, have challenged this theory. They argue that since humans are capable of thinking, we can discover new ways to grow more food. These economists point to the great expansion of crop yields through the use of mechanized agriculture.

In order for students to receive a balanced education, they must be presented with both theories and the evidence which supports them. Students should be able to discuss and debate either side of this issue with equal fluency.

Neo-Malthusian Theories

Neo-Malthusians point out that the world's population has increased enormously during the 20th century. Extrapolating future population numbers from historical rates of growth reveals a badly overcrowded planet. Graphing this population growth produces a "J"-shaped curve demonstrating that population is increasing at an alarming rate. In many countries, they point out, population doubles every 20 to 30 years — putting an unsustainable strain on food and other resources.

Neo-Malthusians say that food production simply won't be able to keep up with food needs. More people will occupy more land, leaving less available to plant the crops needed to sustain life. Even now, proponents of this view argue, overpopulation in underdeveloped nations is causing famines.

Advocates of limiting population growth apply the concept of "carrying capacity" — the amount of land needed to support certain numbers of animals — to human beings. When that capacity is reached, they explain, competition for food becomes intense and animals begin to die off. In their view, humans will face the same fate unless steps are taken to slow population growth. They believe that the human carrying capacity of some areas of

the world may already have been exceeded. Proponents of this view point out that nations with the highest population growth rates are among the poorest per capita. Unless efforts are made to control human population, they warn, the future carrying capacity of the entire Earth could be reached, bringing food and resource shortages and ultimately starvation.

They argue that the environment also is being jeopardized by too many people creating too much pollution, threatening human and planetary health. They suggest that limiting human population growth also is necessary to preserve the Earth's limited store of fossil fuels, metals, and minerals. To prevent starvation, shortages, and ecological disasters in the future, they recommend that government discourage population growth and enact conservation measures.[41]

Critics of Neo-Malthusian Theories

Critics of these theories dispute Malthusian population projections. They point out that the *growth rate* of the world's population peaked in the mid-1960s and is slowing in both industrialized and poor nations. Thus an "S" curve is a more accurate representation of future population trends.[42] Critics say that limiting population growth is unnecessary as well as repressive. They also say that "carrying capacity" is an inappropriate term to apply to human affairs. They argue that people do not have to forage for survival as animals do, but are problem solvers with demonstrated abilities to increase the quantity and quality of the food they grow. They cite the "Green Revolution," the term used to describe the enormous agricultural advances of the past three decades, as evidence of the accomplishments of human ingenuity and technology. They dispute the claim that the world is running out of land for agriculture, citing billions of acres suitable for crop production.[43]

Critics challenge the Malthusian assumption that large populations cause poverty, although they agree that population size may exacerbate the problems that bad political and economic policies create. They cite many reasons for the famines in Africa and other countries, including the use of food as a weapon to subjugate dissident factions.[44] They emphasize that absence of property rights and free markets depresses economic growth by preventing people from benefiting directly from their labor. It is not an accident, they argue, that nations in which property rights are protected enjoy the highest standard of living regardless of population. They point to Japan, Hong Kong, and Singapore — which have few natural resources and very high population densities and yet are among the richest countries in the world.

Critics of Malthusian solutions also say that governmental efforts to control population growth are rarely successful unless backed by significant suppression of individual freedom — measures, they argue, which are not conducive to human progress. This more optimistic assessment of human history sees economic growth as the best antidote for high birth rates, pointing out that as economies grow and families no longer depend on the economic contributions of children, family size always shrinks.[45]

Anti-Malthusians also argue that record population numbers have not brought ecological disaster. The environment is cleaner, not dirtier than in less populated decades. They cite health data showing that people are living longer, healthier lives than ever before in history.

Criteria for Population and Food Issues

To determine whether both sides of the important debate about population and food issues are included, I developed a list of key points on the next page against which I rated the textbooks.

Discussion

Neo-Malthusian theory receives the major emphasis in most of the textbooks students read. The coverage is deficient for arguments opposing Neo-Malthusian thought.

Biosphere: The Realm of Life, published by Scott Foresman, applies the concept of carrying capacity to

human populations without qualification:

> The fundamental question of how large the human population can become is irrevocably tied to what the earth can support — its carrying capacity. If we have learned anything from population studies of other species it is that this capacity cannot be exceeded for long without severe risk — especially, the risk to the environment. Any such damage would lower the environment's carrying capacity and set the stage for a devastating population crash. (p. 776)

While the authors admit that "[t]he range of estimates of the earth's carrying capacity is enormous" and summarize the contrasting views of population biologists, they support the "population crash theory:"

> If we fail to restrain ourselves when we reach the high numbers, we can expect not a gradual decrease in numbers but a massive increase in our death rate — a dieback or crash. It has been calculated that such a crash might kill 50% to 80% of the human population.

Paul Ehrlich is cited as an authority. "Population biologist Paul Ehrlich, writing in 1977, emphasized that this is probably the way our population will stabilize. The dieback, says Ehrlich, will likely be due to a combination of famine, war, disease, and ecological disruption." (p. 777) Students, of course, would not know how many times Ehrlich's doomsday predictions have not come true.

	EXPLAINS THE NEO-MALTHUSIAN THEORY	EXPLAINS THE ARGUMENTS OF THE CRITICS OF NEO-MALTHUSIAN THEORY
World population is increasing at rates faster than the Earth's ability to feed		
Explains Fully	12	1
Inadequate Explanation	10	2
Incorrect Explanation	0	0
Not Mentioned	1	21
Population will exceed the "carrying capacity" of the Earth		
Explains Fully	12	1
Inadequate Explanation	8	0
Incorrect Explanation	0	0
Not Mentioned	3	22
Increased population will cause massive pollution problems		
Explains Fully	6	0
Inadequate Explanation	6	0
Incorrect Explanation	0	3
Not Mentioned	11	20
Overpopulation causes poverty		
Explains Fully	6	0
Inadequate Explanation	5	3
Incorrect Explanation	0	0
Not Mentioned	12	20
Overpopulation will cause the Earth to run out of irreplaceable fossil fuels, metals, and minerals		
Explains Fully	8	0
Inadequate Explanation	9	2
Incorrect Explanation	0	0
Not Mentioned	6	21
Problem requires government action to limit population: family planning, mandatory programs, i.e., China		
Explains Fully	6	
Inadequate Explanation	2	
Incorrect Explanation	0	
Not Mentioned	15	
Applying the concept of "carrying capacity" to humans is inappropriate		
Explains Fully		1
Inadequate Explanation		0
Incorrect Explanation		0
Not Mentioned		22
Starvation in Africa caused by politics and war, not food-growing capacity		
Explains Fully		0
Inadequate Explanation		0
Incorrect Explanation		3
Not Mentioned		20
Economic growth is best way to limit population; the West is level or decreasing		
Explains Fully		0
Inadequate Explanation		3
Incorrect Explanation		0
Not Mentioned		20
High population levels do not cause poverty; Hong Kong, Japan, Singapore		
Explains Fully		0
Inadequate Explanation		2
Incorrect Explanation		0
Not Mentioned		21

Earth Science, published by Silver, Burdett and Ginn, explains the Earth's growing population, but misleads students about the status of the Earth's food supplies. "One of the most serious problems caused by overpopulation is the inability to grow enough food to feed the earth's people." (p. 222) Students should know that food supplies have more than kept up with population growth.

Managing Our Natural Resources, Delmar Publications, is the only text that does not endorse neo-Malthusian theory. "There is no immediate danger of world-wide starvation or death from disease. We are not running out of natural resources. But the challenge before us, managing our natural resources carefully, is more important now than ever before." (p. 25)

World Geography: People and Places, published by Merrill, introduces the section on population by suggesting that teachers institute a role-play in which the class simulates a United Nations meeting "with the purpose of deciding ways in which a population crisis can be avoided or made less severe." The class is to "consider problems of food supply, natural resources supply, population control, and migration." (p. T104)

The concept of a population crisis is further enforced by a section entitled "Population Issues."

> One of the most basic needs threatened by overpopulation is food. Demographers and many other people worry that the world's food supply will not be able to keep up with the growing population. Estimates are that more than 10 million people die each year because they do not have a good diet. More than 500 million people suffer from malnutrition, or not enough nourishment.

The text also suggests that

> [m]any people have come to believe that the solution to food shortages and dwindling natural resources is to reduce population growth. They believe that the birthrate of each country must be lowered, until it is balanced with the death rate. ... Since 1970 it has become the policy of many governments around the world to lower their population growth rates by offering programs for family planning. (p. 123)

Among the nations listed is China, yet China has a much more aggressive approach than offering "family planning programs" and students should be informed of the ramifications of that approach.

The explanation of Malthus' theory is made up of half-truths that reinforce the "population crisis" idea. After explaining that Malthus' theory has not proved true because of improved farming methods and medical advances, the text states,

> Nevertheless, some people argue that these changes have not proved Malthus wrong. Millions of people all over the world are starving. Supporters of Malthus ideas say that improvements in medical care and farming only put off the time when there will be far too many people for Earth to support. (p. 120)

The implication is that "people are starving" because there isn't enough food. Yet, local shortages are associated with wars, misguided economic policies, and political intrigues, rather than scarce world food supplies.

Neo-Malthusian theory is also favored in *Biology*, published by Glencoe. This text states:

> In 1975, the human population on Earth was four billion, or double its size in 1930. By 2020 the human population will probably double its size again, to almost 8.1 billion. Many countries today face food shortages each year. ... One-half of the humans who die each year are children under the age of five. Some of these deaths are caused by diseases, but many of the deaths are caused by starvation. Much of the land in the United States that was available for growing food crops is no longer available. Many farms have been sold, and the land is used for building homes, and new industrial sites. Due to improved farming methods and better fertilizers, however, farmers can now grow more food on less land." (p. 635)

Without examining the causes of local food shortages, students receive only half the information they need to understand the problem. On the same page, under "Background," students are told, "Even though food production has increased in the past forty years in most of the world, the rate of food production has not increased fast enough to keep up with the human population increase." (p. 635)

The authors also suggest that human population growth is subject to the limiting factors that affect other species, such as competition for light, space, water, or food. Students are told,

> Look again at the human population graph in Figure 30-4. The line slants upward showing a rapid increase in population. What does this tell you about the limiting factors in a human population? Could you make a prediction about the human population size in the year 2000? Do you think human populations are affected by limiting factors? (p. 636)

It is clear what answers the authors favor.

Biology: Living Systems, published by Merrill, expresses neo-Malthusian theory. "The human population, like all other populations, interacts with its environment. It cannot continue to expand indefinitely because a point is reached in any population at which the environment cannot support additional growth. Most ecologists think this point will be reached by humans. What do you think?" (p. 687) Given the way in which the population issue is presented, students would agree.

With one notable exception, neo-Malthusian theory is endorsed by textbook treatment of population and food issues — even to the point, in some cases, of twisting the facts to make them fit.

RAIN FORESTS

Introduction

The condition of the world's rain forests is a popular topic in environmental education. The controversy over using rain forests for economic development in tropical countries has two aspects: economic and scientific. The rain forests hold a vast reserve of wealth for these developing countries. The forests are cut for timber and to make way for farming and grazing. Critics charge that this development is short-sighted and has major ecological consequences for the rest of the world. In addition, some scientists argue that clearing rain forest land increases global warming and endangers species.

Excessive Rain Forest Destruction Thesis

Estimates of the number of acres of rain forest that are being destroyed vary widely from 30 acres per minute to 100 or more acres per minute. No one knows the real number — but whatever the figure, critics say that it is too large for rain forests to survive very long. Some estimate that if deforestation isn't stopped, the world's tropical rain forests will disappear entirely by the year 2000. Generally, overpopulation and poverty are blamed. They argue that cutting rain forests for their timber and to make way for farming and grazing doesn't make good economic or environmental sense.

They point out that the soil under rain forests is poor because its nutrients have been absorbed by the trees and other vegetation. Thus, when the land is cleared for agriculture or cattle ranching, the land is able to sustain those activities for only a few years before the soil is exhausted and the farmers and ranchers have to move to newly cleared land. Critics of the practice argue that destruction of rain forests is more than a local tragedy, but that it has worldwide environmental repercussions. The loss of the trees, they say, means that they will no longer be absorbing carbon dioxide through photosynthesis, allowing carbon dioxide levels in the atmosphere to increase and adding to global warming. When forests are cleared by burning, a common practice, huge amounts of carbon dioxide are released, also adding to the global warming problem.

Concern for plant and animal species is another major issue in the debate over rain forest clearing. Critics say that cutting rain forests not only deprives the planet of an important source of oxygen, but threatens extinction of thousands of plant and animal species because their habitat is being destroyed. Although estimates of the number of species threatened with extinction vary widely, there is general agreement that unique genetic material as well as many life-saving medicines will be lost to humanity should the cutting continue.[46]

Critics of Excessive Rain Forest Destruction

Although agreeing that excessive deforestation is poor policy, some scientists have a more moderate view of the practice of cutting rain forests. They tend to be skeptical of high estimates of forest loss, citing studies and satellite photos indicating that rain forest loss is considerably less than has been claimed. Putting the threat to rain forests in perspective, the U.N. Food and Agriculture Organization figures indicate that about 0.8% of the total tropical forest area is cleared each year.[47] Scientists who view rain forest cutting with more equanimity point out that industrial forest plantations in Latin America are reducing cutting in natural forests.

Some scientists and economists also point out that developing societies naturally put pressure on resources, just as the United States once did. However, increased logging need not spell the end of rain forests, because tree plantations are being established to satisfy the demand for wood. The other good news is that even allowing for the poor condition of the soil where rain forests have stood, use of fertilizers and modern farming techniques can make farming and grazing practical.[48]

The outlook for preserving the species that live in the rain forest is also improving. Drug companies are paying for the right to review plants and other rain forest species so they can be preserved.[49] Some scientists also point out that claims that rain forest cutting will increase global warming are highly speculative considering the uncertainty concerning the number of trees being lost and the uncertainties of global warming theory. In any case, although trees do produce oxygen, they contribute only a very small part of the total oxygen in the atmosphere. As to species loss, some scientists say that the small number of species lost to development in Puerto Rico suggests that many species are capable of adapting to habitat changes.

Some economists say that blaming rain forest destruction on greedy lumber companies and western demand for beef doesn't tell the whole story. Governments of developing nations encourage deforestation with generous tax concessions and other development subsidies for agriculture and for cattle ranching.[50] Changing these policies, economists argue, would drastically reduce deforestation.

Fortunately, the news is not all bad. Private international conservation organizations are creating "debt-for-nature" trades in which the organizations raise money to pay off a portion of a country's debt in exchange for rain forest protection. Those who are more optimistic about the future of tropical rain forests say that changing government policies, demand-driven increases in tree farming, and the efforts of private international conservation groups are working.

Rain Forest Criteria

I developed the list of criteria to the left to assess the way textbooks present rain forest cutting to students.

EXPLAINS EXCESSIVE RAIN FOREST DESTRUCTION THESIS	
Figure for high rate of rain forest destruction is given	
Explains Fully	17
Inadequate Explanation	2
Incorrect Explanation	0
Not Mentioned	0
Overpopulation and poverty are given as the reasons for rain forest destruction	
Explains Fully	4
Inadequate Explanation	3
Incorrect Explanation	0
Not Mentioned	12
Explains that rain forest land is not suitable for agriculture and grazing	
Explains Fully	9
Inadequate Explanation	3
Incorrect Explanation	0
Not Mentioned	7
Creation of carbon dioxide through burning and destruction of trees — contributes to global warming	
Explains Fully	13
Inadequate Explanation	1
Incorrect Explanation	0
Not Mentioned	5
Loss of species is great, with dire consequences	
Explains Fully	11
Inadequate Explanation	6
Incorrect Explanation	0
Not Mentioned	2
International governmental actions necessary to solve problem	
Explains Fully	0
Inadequate Explanation	9
Incorrect Explanation	0
Not Mentioned	10

EXPLAINS THE ARGUMENTS OF THE CRITICS OF EXCESSIVE RAIN FOREST DESTRUCTION THESIS	
Provides data which questions the high rate of rain forest destruction	
Explains Fully	0
Inadequate Explanation	0
Incorrect Explanation	0
Not Mentioned	19
Use of rain forest natural resources is necessary for economic development and is temporary — minimal long-term damage	
Explains Fully	0
Inadequate Explanation	5
Incorrect Explanation	0
Not Mentioned	14
Actions by drug companies to save species and "debt for nature" programs	
Explains Fully	2
Inadequate Explanation	2
Incorrect Explanation	0
Not Mentioned	15
Governments and international organizations are the problem — they provide incentives for inappropriate development of rain forests	
Explains Fully	0
Inadequate Explanation	3
Incorrect Explanation	0
Not Mentioned	16
Increased economic development of these nations will relieve the pressure on their reliance on natural resources	
Explains Fully	1
Inadequate Explanation	0
Incorrect Explanation	0
Not Mentioned	18

Discussion

The excessive rain forest destruction thesis is emphasized in all the texts that covet the rain forest issue. Arguments challenging that point of view either are not discussed at all or are given slight attention.

World Regions, published by Macmillan/McGraw-Hill, includes a pro/con feature to provide arguments for economic development as well rain forests preservation. However, the preservation side is bolstered by instructions to the teacher to

> [h]ave students focus on how the destruction of the distant Amazon rain forest might affect their own environment. To aid students, have them study media coverage of the issue. Point out the effect that the destruction of the Amazon rain forest could have on world environmental systems, such as global warming that would make the oceans rise; the supply of oxygen; and the supply of water vapor for clouds. Then have students create and maintain two bulletin boards, showing news items in newspapers and magazines supporting both sides of the debate. (p. 169) The rain forests of South America, Africa, and Asia are being cut down at an extremely high rate to make room for farmland. Each year 100,000 square kilometers of rain forest are destroyed. That is an area equal to 38 football fields being destroyed every minute. ... Scientists estimate that over 100 species of plants in these forests are becoming extinct each day. (p. 675)

Although the "focus" the teacher is instructed to provide is one-sided, this text is better than *Biology*, published by Prentice Hall, which gives students a one-line explanation of the economic problems of people who support economic development of rain forests: "But people who live in these areas argue that they cannot preserve the rain forest without sacrificing their own survival. As in most issues, both sides have a valid point." This follows four paragraphs critical of rain forest destruction. (pp. 326-27)

Creative reporting of the amount of rain forest destruction is demonstrated by the next three texts. *World Geography: The Earth and Its People*, published by Harcourt Brace Jovanovich, offers, "According to the latest estimates, during every minute of the day people destroy at least 100 acres (40 hectares) of tropical rain forest." (p. 367)

Biology Today, published by Holt, suggests another estimate: "Over the past few years, developers have been destroying rain forests at an average rate of about 50 acres a minute." (p. 76)

Biology, published by Glencoe, estimates:

> The rain forests of South America, Africa, and Asia are being cut down at an extremely high rate to make room for farmland. Each year 100,000 square kilometers of rain forest are destroyed. That is an area equal to 38 football fields being destroyed every minute. ... Scientists estimate that over 100 species of plants in these forests are becoming extinct each day. (p. 675)

The wide range of "estimates" reveals that the actual extent of rain forest destruction is largely guesswork. However, that doesn't stop textbook authors from postulating high numbers to underscore the excessive rain forest destruction thesis.

RECYCLING

Introduction

Recycling is a popular activity for children interested in helping the environment. Recycling offers children an opportunity to actually do something to help the environment. Recycling curriculum materials often begin in preschool and kindergarten. Teachers who teach recycling at this level argue that it is necessary to encourage the development of new recycling habits during these early years. But critics of recycling education argue that recycling has been reduced to mere slogans which propagandize rather than educate. They argue that a full understanding of recycling means an understanding of the complex economic issues involved, and this demands the knowledge and maturity of higher grade levels. These critics argue that children want to do something to help the environment, but first they need to understand the full implications of recycling.

This disagreement over recycling can be summarized by reviewing the two major ways recycling occurs: government- and market-based recycling.

Government-Based Recycling

Advocates of government recycling programs recommend tax-supported curbside recycling and other government-mandated recycling programs. It isn't right to throw away things that can be salvaged and reused, they argue. For example, recycling newsprint, they point out, would save our trees and forests. They generally present recycling as an unqualified good that conserves natural resources, energy, and landfill space. The general public agrees with them. A 1990 public-opinion survey indicated that 92% of the respondents believe that a "major commitment to recycling will substantially reduce the nation's solid waste."

Scrap recyclers have recycled cars for years along with ferrous metals, glass, paper, and plastic for many years. In some cases, proponents of mandatory recycling favor banning products that cannot be recycled, citing a shortage of landfill space and energy and other savings. For example, it takes 20 times the energy to produce an aluminum can from raw ore than it does to make a can from recycled cans.

Around the country, about 85% of our trash is buried in landfills. Recycling could cut that number dramatically. They argue that people in other countries recycle much more of their trash than Americans do and that we should follow their example. They suggest that government help create demand for recycled products by buying these products even when they are more expensive than alternatives.[51]

Market-Based Recycling

Advocates of market-based recycling argue that recycling is neither good nor bad. It depends upon whether transporting, sorting, and processing recyclables can be done economically and with less impact on the environment than products produced from raw materials. The recycling process itself may generate large amounts of hazardous waste — such as does de-inking newsprint, for example. Just as important is whether people will buy goods produced from recycled materials. Although it is true that recycling can conserve resources, it is not always the case. Many trees, for example, are grown because of market demand for lumber and pulp and would not otherwise be planted. They also point out that the popular perception that large reductions in solid waste would result from recycling is unrealistic and that perhaps no more than 20% to 30% of the waste stream can be economically recycled.

Markets, not governments, they argue, determine whether recycling represents the best use of resources. Mandatory laws that ignore markets force higher costs on consumers. Instead of mandatory recycling programs, proponents of market-based recycling argue that the best way to encourage recycling is to charge people according to the waste they produce. They report that cities which charge users' fees for trash collection and disposal experience an almost immediate increase in voluntary recycling and a decrease in the quantity of trash generated.[52]

Recycling Criteria

To discern how recycling is presented to students, I developed the criteria on the next page.

Discussion

As the chart indicates, recycling issues are incompletely covered. The texts emphasize the positive aspects of recycling, but largely fail to indicate that recycling is only complete when recycled products are made into new products and accepted by consumers. The texts almost always fail to mention the economic basis of recycling. Students rarely learn the market basis for recycling.

Earth Science, published by Scott Foresman, makes the blanket statement:

It costs less to recycle a material, such as iron, than to extract that material from raw resources, such as iron ore. Recycling also helps conserve other resources. For example, recycling paper saves trees. The process of recycling can cause some kinds of pollution, but, again, not as much as making or taking that material from raw resources. (p. 622)

As I have pointed out, it is not always the case that recycling saves resources, especially if the energy expended in collecting and transporting recyclables is taken into account.

In *Biology: The Dynamics of Life*, published by Merrill, the authors note that if we do not recycle aluminum cans, we may run out of aluminum. (p. 766) Aluminum is one of the most abundant metals in the Earth's crust. The reason that there is a high demand for recycling aluminum is that recycling cans uses less electricity than making new cans from aluminum ore. This text also makes the incorrect statement that "[a] major source of waste in today's landfills is disposable diapers." (p. 767) As William Rathje has demonstrated in his landfill studies, the major household wastes are newspapers and yard waste.

EXPLAINS THE FULL CYCLE OF RECYCLING

Recycling is not completed until the recycled products are made into new products and these products are purchased in stores

Explains Fully	4
Inadequate Explanation	4
Incorrect Explanation	0
Not Mentioned	10

EXPLAINS THE GOVERNMENT-BASED RECYCLING ARGUMENTS

Recycling is important because it conserves energy, natural resources, and landfill space

Explains Fully	13
Inadequate Explanation	3
Incorrect Explanation	0
Not Mentioned	2

These goals are so important they cannot be left up to the market to handle — must have government participation and incentives to encourage, i.e., mandatory curbside recycling, etc.

Explains Fully	3
Inadequate Explanation	4
Incorrect Explanation	0
Not Mentioned	11

Americans are especially wasteful — more wasteful than people in foreign countries; they produce less waste and recycle more

Explains Fully	5
Inadequate Explanation	2
Incorrect Explanation	0
Not Mentioned	11

Americans must change their overconsumptive ways and reuse, reduce, and recycle

Explains Fully	11
Inadequate Explanation	6
Incorrect Explanation	0
Not Mentioned	1

EXPLAINS MARKET-BASED RECYCLING

The best way to take all factors into account in recycling is to leave it to the market , i.e., energy used to haul recycled products vs. energy to produce new products, etc.

Explains Fully	0
Inadequate Explanation	1
Incorrect Explanation	0
Not Mentioned	17

Mandatory programs often impose costs on consumers and taxpayers which are not accounted for in determining costs — and other unintended consequences

Explains Fully	0
Inadequate Explanation	1
Incorrect Explanation	0
Not Mentioned	17

Landfill space, with all its problems, is often cheaper than recycling

Explains Fully	0
Inadequate Explanation	2
Incorrect Explanation	0
Not Mentioned	16

Americans are not necessarily more wasteful than foreigners — Mexico study by Rathje

Explains Fully	0
Inadequate Explanation	0
Incorrect Explanation	0
Not Mentioned	18

Health, published by Holt, strongly endorses recycling and bends the facts to support that endorsement.

> About 80 percent of the solid waste produced is reusable. Advantages of reusing these materials include reducing the volume of solid waste and slowing down the rate at which resources are removed from the environment. Unfortunately, it costs more in many instances to recycle items than to produce them from scratch." (p. 554)

Eighty percent is an unrealistically high figure reached by ignoring the economic aspects of recycling. This text also seeks to involve students in political action to promote recycling.

> Have students find out if their community has a recycling program. ... If no recycling program exists, have students organize a campaign to start a recycling program in the community. Students can write letters to

> local officials and put up posters in the school and around the community urging that the local government start a recycling program." (p. 555)

Unfortunately, on the basis of the explanation provided in this text, students would be poorly informed about the realities and economics of recycling.

It is unfortunate that students are given such an incomplete and sometimes inaccurate picture of recycling. Students often spend many hours recycling. Because their texts mislead them, they are laboring under misconceptions about their efforts.

SOLID WASTE DISPOSAL

Introduction

Solid waste disposal is usually part of environmental education. The "landfill crisis" is presented as one of the major issues confronting our society. Students are urged to "reduce, reuse and recycle" — the new 3 Rs in many schools. A different view says that the so-called landfill crisis is based on fundamental misunderstandings of the science and economics of solid waste. These critics expose many of the myths of landfill construction and operation and point to the lack of economic incentives which would naturally solve many of our packaging, landfill siting, and consumption problems. It is important for students to understand both sides of this environmental debate.

The Solid Waste Crisis

Some people are fearful that the United States is in danger of being buried in its own garbage. They describe a garbage crisis of declining landfill capacity and increasing waste — too many people producing too much trash for which we have too little space.

Most landfills are built to last only about 10 years and are reaching capacity. Not only is the nation running out of space to replace them, but people worry that landfills pollute ground water and emit volatile gases that endanger human health. There are four principal approaches to disposing of solid waste: putting it in landfills, incinerating, recycling, and reducing the amount of waste. Those who are convinced that the problem is reaching crisis proportions favor lifestyle changes to reduce the amount of trash generated, suggesting that Americans simply do not need many of the items that contribute to the landfill problem. In this view, the best way to deal with solid waste is not to produce it in the first place. They suggest laws to discourage or ban the use of certain fast food packaging, polystyrenes, and other non-degradable items that end up in landfills. Much emphasis is on reducing or eliminating polystyrene foam used in packing materials, meat trays, and fast food containers because of the landfill space they consume and because they do not degrade.

The second best way is to recycle They recommend mandated recycling to reduce the amount of waste dumped in landfills and to conserve resources. Another recommendation is for government to regulate waste by charging manufacturers advance disposal fees to cover the cost related to disposing of each item or product. They also recommend laws to mandate return deposits on plastic and glass containers and to require manufacturers to include certain levels of recyclable materials in their products. They criticize Americans for being more wasteful than people in other countries, exacerbating our waste disposal problem.[53]

The Crisis is Largely Artificial

The alternative view sees a problem but no crisis. We are not short of physical space for landfills, although that varies state by state. What we lack is public willingness to build them, pay for them, or have them located nearby. Those who take a less alarmist view of the landfill problem point out that solid waste is not a special type of product, immune from the laws of economics. Successful waste management, they argue, is based on economic incentives, not government fiat.

Blanket prescriptions such as banning non-degradables do not work because in some old landfills, biodegradable products can be worse for the environment than products which are inert and cannot degrade into soil and groundwater. Modern landfills, they point out, do not threaten the environment. In fact, modern landfills make the degradable vs. non-degradable argument meaningless, because they are designed to keep out air and water — ingredients necessary for biodegrading to occur. Product bans also are often based on false premises about what consumes the most landfill space. Studies show that fast food packaging, polystyrene, and disposable diapers actually occupy a very small portion of landfill space by either weight or volume. In addition, food packaging reduces spoilage and the amount of food by-products that families discard. These by-products are processed commercially for animal feed and other uses. The also point out that there already are strong economic incentives to make products as compact and light as possible for ease of distribution and to conserve resources. Finally, they argue that the fees and restrictions advocated would raise consumer costs enormously and regiment much of our economy.

Instead, critics of government waste management suggest that governments stop subsidizing solid waste disposal and hiding the costs in broad general taxes and start making disposal fees cover the true costs of collecting and disposing of waste, including the costs of environmental protection. Consumers would then have financial incentives to generate less waste and voluntarily recycle. They also point out that landfills that are privatized and operate at a profit have reduced resistance to site landfills by offering a lucrative source of municipal revenue.[54]

Criteria for Solid Waste Disposal

How to dispose of solid wastes is a question that will continue to concern future generations. Students, therefore, should be informed about a range of possible solutions. I used the criteria to the right to assess textbook treatment of the issue.

Discussion

The texts rarely provide an accurate explanation of why

EXPLAINS THE SOLID WASTE CRISIS ARGUMENTS

Landfills are being closed and new ones not opened — will run out soon

Explains Fully	10
Inadequate Explanation	6
Incorrect Explanation	0
Not Mentioned	2

To save landfill space, government should ban products — styrofoam, diapers ,etc.

Explains Fully	0
Inadequate Explanation	3
Incorrect Explanation	0
Not Mentioned	15

Americans especially wasteful — more than foreigners

Explains Fully	6
Inadequate Explanation	4
Incorrect Explanation	0
Not Mentioned	8

Must have mandatory recycling

Explains Fully	3
Inadequate Explanation	3
Incorrect Explanation	0
Not Mentioned	12

Landfills create ground water pollution and other problems

Explains Fully	8
Inadequate Explanation	3
Incorrect Explanation	0
Not Mentioned	7

EXPLAINS THE ARGUMENTS OF THE CRITICS OF SOLID WASTE CRISIS

Landfill space is a political problem (NIMBY) not lack of physical space

Explains Fully	0
Inadequate Explanation	0
Incorrect Explanation	1
Not Mentioned	17

Need economic incentives to encourage people to accept new landfills

Explains Fully	0
Inadequate Explanation	1
Incorrect Explanation	0
Not Mentioned	17

The number of landfills closing and opening is meaningless because old landfills should close and new ones are larger and safer

Explains Fully	0
Inadequate Explanation	1
Incorrect Explanation	0
Not Mentioned	17

Biodegradable is meaningless because in most landfills nothing degrades — or degrades very, very slowly

Explains Fully	0
Inadequate Explanation	1
Incorrect Explanation	0
Not Mentioned	17

Americans are not more wasteful — Rathje's Mexico study

Explains Fully	0
Inadequate Explanation	0
Incorrect Explanation	1
Not Mentioned	17

Solution — create incentives to reduce trash by charging for trash by volume

Explains Fully	0
Inadequate Explanation	0
Incorrect Explanation	0
Not Mentioned	18

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more landfills are not being built. They do not explain why modern landfills make biodegradability irrelevant. Texts tend to be inaccurate about what consumes the most landfill space.

Earth Science, published by Prentice Hall, offers a student activity. Students measure the decomposition of items in a simulated landfill (a glass jar filled with layers of soil, water and different items of trash). Students are supposed to determine what decomposes and what doesn't and conclude that "the landfill should only contain litter that comes from plant or animal sources" because these will cause "few long-term litter or pollution problems." The only mention that there are different types of landfills is a suggestion to the teacher: "You may want to have students report, prior to the investigation, about the different types of landfills and why some are better than others." (pp. 568-69)

Biology, published by Prentice Hall, states, "Sanitary landfills, especially those near large cities, are almost filled to overflowing. One solution to the solid waste problem is recycling." (p. 1070) Although recycling may reduce the amount of solid waste, it is hardly the "solution" to the solid waste problem.

Life Science, published by Harcourt Brace Jovanovich, discusses biodegradable and nonbiodegradable materials, explaining that the former "can be broken down by microorganisms," but the latter "wastes remain in the ecosystem forever." (p. 548) The authors, however, neglect to mention that the distinction matters little in modern sanitary landfills where biodegradation is minimal. The text also states that although sanitary landfills are "an effective way of dealing with solid waste," the problem is that "many communities are running out of sites for sanitary landfills." (p. 550) This leaves the impression that the problem is one of physical space rather than community resistance.

Teen Health, published by Glencoe, clearly supports the idea that government has the answer to environmental problems.

> Government plays an important role in controlling pollution. Laws control what is done with waste. Other rules set standards for clear air and water. People who are concerned about having a clean environment can work with local and national leaders. They can use their power as citizens to get laws passed. (p. 435)

Health: Skills for Wellness, published by Prentice Hall, misleads students about the nature of the solid waste dilemma. "One problem with landfills is that space for them is running out. Many landfills across the country are at or near full capacity." These statements lead students to the conclusion that we are running out of land on which to put landfills. The truth is that public reluctance, not lack of physical space, is the reason for the landfill crunch. This text also encourages students to change their parents' behavior on environmental issues. "Some students may encounter resistance at home when they try to encourage environmentally conscious behavior such as recycling. Reinforce the idea that even small changes in behavior are important. Encourage students to be patient." (p. 614)

Biology, published by Glencoe, condemns plastics for not degrading in landfills, even though degradation is not a significant factor in modern landfills.

> In a few days, the bits of food begin to rot. ... After several weeks, the food and paper have rotted away. The plastic is still there. ... Think of all the plastic items that people throw away each day. None of them are biodegradable. Dumps and landfills are becoming filled with these items. We are running out of places to put them. (p. 685)

These textbook discussions of solid waste generally parrot popular misconceptions about solid waste and recycling and offer students little, if any, balanced information. Unfortunately, that means that students' understanding will be limited and they will not be prepared to deal with these issues in an informed manner.

CONCLUSION

The findings of this study reveal that the environmental education of Wisconsin students is not only deficient in vital areas, but is marked by a consistently pessimistic view of the future. Such a world view short-circuits thinking and leads students to accept as fact ideas that are still being debated within the scientific and economic communities.

To fulfill its mandate, environmental education should provide a balanced presentation of scientific and economic thought about environmental issues. To nourish the spirit of inquiry and critical thinking skills of Wisconsin students, texts also should clearly distinguish between fact and theory. In addition, students should understand that if economic growth and technology adversely impact the natural world, they also produce benefits for both humans and nature.

Meeting major environmental challenges requires open minds, a solid grounding in science, and an understanding of how economic considerations influence decision-making. In short, to become astute problem-solvers, students should be prepared to consider the widest range of possible solutions. An appropriate environmental education engages students' curiosity and motivates them to join the search for solutions.

Unfortunately, the vast majority of textbooks used in Wisconsin schools fail to provide students with a fair, balanced, and objective environmental education.

NOTES

1 Using a list of Wisconsin school districts ranked by student size, four large (more than 8,000 students), five medium (1,000 to 8,000 students), and three small (less than 1,000 students) school districts were selected. Of the 15 large districts, every fourth district was selected. Of the 196 medium districts, every 40th district was selected. Of the 216 small districts, every 72nd district was selected. (Only K-12 districts were selected.)

2 School districts typically supply abbreviated bibliographic information on the textbooks used in the district. This usually includes short title, publisher, and publication date. Confusion can occur when a full list of authors and full titles are not provided. The author provides full bibliographic entries in Appendix A and apologizes for any inaccuracies in that bibliography.

3 John J. McKetta, Jr., *Acid Rain: The Whole Story To Date* (Louisville, KY: National Council for Environmental Balance, Inc., 1988), p. 4.

4 See McKetta.

5 National Acid Precipitation Assessment Program (NAPAP), Integrated Assessment: Questions 1 and 2, External Review Draft, Question 1, 2-11, August 1990.

6 Edward C. Krug, "Fish Story," *PolicyReview*, Spring 1990, pp. 44-48.

7 NAPAP, "Assessment Highlights," September 5, 1990, pp. 6-19.

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9 Jo Kwong Echard, *Protecting the Environment: Old Rhetoric, New Imperatives* (Washington, DC: Capital Research Center, 1990), pp. 1-14.

10 Roger A. Sedjo, "Forest Resources: Resilient and Serviceable," in *America's Renewable Resources*, edited by Kenneth D. Frederick and Roger A. Sedjo (Washington, DC: Resources for the Future, 1991), pp. 96-97.

11 *Evergreen* (1993), Fig. 8, p. 8.

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13 Donald R. Leal, *Receipts and Costs of Logging on Government Forests: A Federal and State Comparison in Montana*, Working Paper 93-7, Political Economy Research Center (PERC), Bozeman, MT, 1993.

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15 Ehrlich and Wilson, p. 758.

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18 Charles C. Mann, "Extinction: Are Ecologists Crying Wolf?" *Science*, Vol. 253, August 16, 1991, p. 738.

19 Julian L. Simon and Aaron Wildavsky, "Assessing the Empirical Basis of the 'Biodiversity Crisis,'" Competitive Enterprise Institute, Washington, DC, May 1993.

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22 See Donella H. Meadows, et al., *The Limits to Growth: A Report of the Club of Rome's Project on the Predicament of Mankind* (New York: Universe Books, 1972).

23 See James D. Gwartney and Richard L. Stroup, *Economics: Private and Public Choice* (New York: Harcourt Brace Jovanovich, 1987).

24 Stephen Moore, *Doomsday Delayed: America's Surprisingly Bright Natural Resource Future*, IPI Policy Report No. 118 (Lewisville, TX: The Institute for Policy Innovation, August 1992), p. 3.

25 Sylvan H. Wittwer, *The Greenhouse Effect* (Burlington, NC: Carolina Biological Supply Company, 1988), p. 3.

26 Robert R. Balling, Jr., *The Heated Debate: Greenhouse Predictions Versus Climate Reality* (San Francisco: Pacific Research Institute for Public Policy, 1992), p. 23.

27 Wittwer, p. 6.

28 Patrick J. Michaels, "Crisis in Politics of Climate Change Looms on Horizon," *Forum for Applied Research and Public Policy* (Winter 1989), p. 15.

29 Robert Jastrow, William A. Nierenberg, and Frederick Seitz, "An Overview," *Scientific Perspectives on the Greenhouse Problem* (Ottawa, IL: Jameson Books, Inc., 1990), p. 11.

30 Aaron Wildavsky, "Introduction" to *The Heated Debate: Greenhouse Predictions versus Climate Reality*, by Robert C. Balling, Jr. (San Francisco: Pacific Research Institute for Public Policy, 1992), p. xxiv.

31 Tim Beardsley, "Night Heat," *Scientific American*, February 1992, pp. 21-22.

32 Sylvan H. Wittwer, "Flower Power: Rising Carbon Dioxide is Great for Plants," *Policy Review*, Fall 1992, pp. 4-9.

33 Ron Bailey, *Eco-Scam: The False Prophets of Ecological Apocalypse* (New York: St. Martin's Press, 1993), p. 126.

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42 Dennis T. Avery, *Global Food Progress 1991: A Report From Hudson Institute's Center for Global Food Issues* (Indianapolis: The Hudson Institute, 1991), pp. 70-73.

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44 Avery, p. 12.

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50 Dennis J. Mahar, "Government Policies and Deforestation in Brazil's Amazon Region," pamphlet, The World Bank, Washington, DC, 1989, p. 9.

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53 See Blumber and Tottlieb.

54 Scarlett, Rathje and Murphy.

ABOUT THE AUTHOR

Michael Sanera is an associate professor of political science at Northern Arizona University in Flagstaff, Ariz., and president of the Arizona Institute for Public Policy Research in Tucson, Ariz. He is co-author of *Mandate for Leadership II: Continuing the Conservative Revolution* and co-editor of *Steering the Elephant: How Washington Works*.

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Dr. Sanera earned a B.A. from Arizona State University in Tempe, Ariz., an M.A. from Boston University, and a Ph.D. in political science from the University of Colorado at Boulder.

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APPENDIX A: WISCONSIN SCHOOL DISTRICTS AND TEXTS

SCHOOL DISTRICT CODES AND DATA

Code		School District	# of Students (1994-95)	Size Rank
Large Districts				
(More than 8,000 students; 33% of total state students)				
Mil	=	Milwaukee	98,009	1
Ken	=	Kenosha	18,155	5
Jan	=	Janesville	10,368	9
SP	=	Stevens Point Area	8,558	14
Medium Districts				
(1,000 to 8,000 students; 53% of total state students)				
Sup	=	Superior	5,678	23
Def	=	DeForest Area	2,916	63
Ell	=	Ellsworth Community	1,959	103
Vir	=	Viroqua Area	1,436	144
May	=	Mayville	1,198	183
Small Districts				
(Fewer than 1,000 students; 14% of total state students)				
Aub	=	Auburndale	890	234
ES	=	Eleva-Strum	642	306
Ith	=	Ithaca	360	378

TEXTBOOKS REVIEWED

(School district codes follow textbook entries indicating where each text is used)

Author's Note: School districts typically supply abbreviated bibliographic information on the textbooks used in the district. This usually includes short title, publisher, and publication date. Confusion can occur when a full list of authors and full titles are not provided. The author provides full bibliographical entries below and apologizes for any inaccuracies in this bibliography.

Geography

Bacon, Phillip, *World Geography: The Earth and Its People* (Orlando, FL: Harcourt Brace Jovanovich,1989) (Mil-1989)

Banks, James A., et al., *World Regions* (Riverside, NJ: Macmillan/McGraw-Hill, 1993) (Jan-1993)

Boehm, Richard G., and Swanson, James L., *Glencoe World Geography* (Mission Hills, CA: Glencoe/McGraw-Hill,1989) (Mil-1989)

Cooper, Kenneth S., *The Eastern Hemisphere* (Morristown, NJ: Silver, Burdett and Ginn, 1991) (Ken-1991) (Sup-1988)

Gritzner, Charles, *World Geography* (Lexington, MA: D.C. Heath, 1989) (Ken-1989) (Vir-1987)

Hunkins, Francis P., and Armstrong, David G., *World Geography, People and Places* (Columbus, OH: Merrill Publishing Co., 1984) (ES-1989)

Israel, Saul, Johnson, Douglas, and Wood, Dennis, *World Geography Today* (New York: Holt, Rinehart and Winston 1980) (Mil-1989)

Sager, Robert J., Helgren, David M., and Israel, Saul, *World Geography Today* (Austin, TX: Holt, Rinehart and Winston, 1995) (Def-1995)

Schwartz, Melvin, and O'Conner, John, *Exploring A Changing World* (Englewood Cliffs, NJ: Globe Book Co., 1993) (Aub-1993)

Health

Getchell, Pippin, Varnes, et al., *Health* (Boston, MA: Houghton Mifflin,1987) (Ken-1989)

Getchell, Pippin, Varnes, et al., *Perspectives on Health* (Lexington, MA: D.C. Heath, 1994) (Mil-1994)

Greenberg, Jerrold, and Gold, Robert, *Holt Health* (Orlando, FL: Holt, Rinehart and Winston, Inc., 1994) (Mil-1994)

Jones, Henke L, Tsumura, Ted, and Bonekemper, T., et al., *Health and Safety for You* (Columbus, OH: Glencoe/McGraw-Hill, 1987) (Sup-1987)

Meeks, Linda, and Heit, Philip, *Health: A Wellness Approach* (Columbus, OH: Merrill Publishing Co., 1990) (Ken -1990)

Meeks, Linda, and Heit, Philip, *Health: Focus on You* (Columbus, OH: Charles E. Merrill, 1990) (ES-1990) (Jan-1990)

Merki, et al., *Health: A Guide to Wellness* , 3rd ed., (Columbus, OH: Glencoe, 1993) (Aub 1993)

Merki, et al., *Teen Health* (Columbus, OH: Glencoe/McGraw-Hill, 1990) (Def-1990) (Aub-1993)

Pruitt, Crumpler, et al., *Health: Skills for Wellness* (Englewood Cliffs, NJ: Prentice Hall,1994) (Mil-1994)

Richmond, Julius B., Pounds, Elenore T., and Corbin, Charles B., *Health for Life* (Glenview, IL: Scott, Foresman and Co.,1990) (ES-1990)

Science

Biology

Arms, Karen, and Camp, Pamela, *Biology* (Austin, TX: Holt, Rinehart and Winston,1995) (Mil -1995)

Biggs, Alton, et al., *Biology: The Dynamics of Life* (Columbus, OH: Merrill Publishing Co., 1991) (Ken-1991)

Essnfeld, Bernice, Gontag, Carol, Moore, Randy, et al., *Biology* (Reading, MA: Addison-Wesley, 1994) (SP-1994)

Goodman, Graham, Emmel, et al., *Biology* (Orlando, FL: Harcourt Brace Jovanovich, 1989) (Mil-1989)

Goodman, Harvey D., et al., *Biology Today* (Austin, TX: Holt, Rinehart and Winston, 1991) (May-1991) (Vir-1991)

Kaskel, Albert, Hummer, Paul J., Jr., and Daniel, Lucy, *Biology, An Everyday Experience* (Lake Forest, IL: Merrill/Glencoe, 1992) (Sup-1992)

Miller, Kenneth, and Levine, Joseph, *Prentice Hall Biology* (Englewood Cliffs, N.J.: Prentice Hall, 1993) (Ken-1993)

Oram, Raymond F., *Biology, Living Systems* (Columbus, OH: Merrill Publishing Co., 1989) (Ith-1989)

Ramsey, et al., *Modern Earth Science* (Orlando, FL: Holt, Rinehart and Winston, 1989) (Ken-1992)

BSCS, Green Version, *Biological Science: An Ecological Approach* (Dubuque, IA: Kendall/Hunt Publishing Company, 1992) (Ken-1992)
Towle, Albert, *Modern Biology*, Annotated Teacher's Edition (Austin, TX: Holt, Rinehart and Winston, 1993) (Def-1993) (Sup-1991) (ES-1993) (Aub-1993) (Ell-1993)
Wallace, King, Sanders, et al., *Biosphere: The Realm of Life* (Glenview, IL: Scott Foresman, 1988) (Ken-1988)

Earth Science

Alexander, Fiegel, et al., *Silver Burdett Earth Science* (Morristown, NJ: Silver, Burdett and Ginn, 1990) (Ken-1990)
Barber, Kissamis, et al., *Earth Science* (Glenview, IL: Scott Foresman, 1990) (Ken-1990)
Cobel, Charles R., et al., *Earth Science* (Englewood Cliffs, NJ: Prentice Hall, 1991) (Jan-1991)
Feather, Ralph M., Jr., Snyder, Susan Leach, and Hesser, Dale T., *Merrill Earth Science* (Lake Forest, IL: Glencoe/Macmillan/McGraw-Hill, 1993) (Sup-1993) (Aub-1993) (Ell-1993) (SP-1993)
Spaulding, Nancy, and Namowitz, Samuel, *Heath Earth Science* (Indianapolis, IN: D.C. Heath, 1994) (May-1994) (ES-1994)

General Science

Brockway, Carolyn Sheets, Gardner, Robert, and Howe, Samuel F., *Allyn and Bacon General Science* (Newton, MA: Allyn and Bacon, 1985) (Ith-1985)
Dispezio, Linner, and Lube, Lisowski, *Science Insights: Exploring Earth and Space* (Reading, MA: Addison-Wesley, 1995) (Def-1995)
Feather, Ralph M., et al., *Science Connections: Red Edition* (Columbus OH: Merrill Publishing Co., 1990) (Def-1992) (Mil-1993)
Heimler, Charles H., and Neal, Charles D., *Principles of Science: Book 2* (Columbus, OH: Charles E. Merrill Publishing Co., 1986) (Mil-1986)
McFadden, Charles, and Yager, Robert, *SciencePlus: Technology and Society, Red Edition* (Austin, TX: Holt, Rinehart and Winston/Harcourt Brace Jovanovich, 1993)
Ramsey, Gabriel, McQuirk, Phillips, Watenpaugh, et al., *General Science* (New York: Holt, Rinehart and Winston,1988) (Vir-1988)

Life Science

Daniel, Lucy, Ortleb, Edward Paul, and Biggs, Alton, *Merrill Life Science* (Columbus, OH: Glencoe/Macmillan/McGraw-Hill, 1994) (Ken-1994)(May-1994) (SP-1994) (Aub-1994) (Ell-1994)
Jantzen, Michel, et al., *Life Science* (New York: Macmillan, 1986) (Ith-1989)
Watkins, Patricia, Leto, Glenn, and Wynn, T., *Life Science* (Orlando, FL: Harcourt Brace Jovanovich, 1989) (Jan-1989)
Wright, Jill, et al., *Prentice Hall Life Science* (Englewood Cliffs, NJ: Prentice Hall, 1991) (Sup-1991)

Misc. Science

Camp, Daugherty, and Kirts, *Managing Our Natural Resources* (Albany, NY: Delmar Publishers Inc., 1991) (ES-1991)
Camp, William, and Donahue, Roy, *Environmental Science: For Agriculture and the Life Sciences* (Albany, NY: Delmar Publishers, Inc., 1994) (ES-1994)
Chiras, Daniel D., *Environmental Science: A Framework for Decisionmaking* (Menlo Park, CA: Addison-Wesley,1989) (SP-1989)
Christensen, John W., *Global Science*, 3rd ed. (Dubuque, IA: Kendall/Hunt Publishing Co., 1991) (Mil-1994))
Maton, Anthea, *Human Biology and Health*, 2d ed. (Englewood Cliffs, NJ: Prentice Hall, 1994) (SP-1994))
Maton, Anthea, *Ecology: Earth's Natural Resources*, 2d ed. (Englewood Cliffs, NJ: Prentice Hall,1994) (SP-1994)
Maton, Anthea, *Matter: Building Block of the Universe*, 2d ed.(Englewood Cliffs, NJ: Prentice Hall, 1994) (SP-1994)
Wright, Nebel J., and Wright, Richard T., *Environmental Science: The Way the World Works*, 4th ed. (Englewood Cliffs, NJ: Prentice Hall, 1991) (Vir-1991)

Physical Science

Alexander, Fiegel, et al., *Silver Burdett Physical Science* (Morristown, NJ: Silver, Burdett and Ginn, 1990) (Ken-1990)
Carle, Mark A, Sarquis, Mickey, and Nolan, Louise M., *Physical Science: Challenge of Discovery* (Lexington, MA: D.C. Heath,1991) (Ith-1991) (SP-1991)
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Ely and Norton, *Physical Science* (Riverside, NJ: Macmillan/McGraw-Hill, 1986) (Mil-1986)
Haber-Shaim, Yuri, *Introduction to Physical Science* (Englewood Cliffs, NJ: Prentice Hall, 1987) (May-1987)
Hurd, Dean, *Prentice Hall Physical Science* (Englewood Cliffs, NJ: Prentice Hall, 1991) (Ken-1991) (Jan-1991)
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Thompson, McLaughlin, and Smith, *Merrill Physical Science* (Columbus, OH: Glencoe/McGraw-Hill, 1993) (Ken-1993) (Def-1995) (May-1993) (Vir-1993) (Ell-1993) (Aub-1991)

APPENDIX B: TEXTBOOK REVIEW WORKSHEETS

ACID RAIN WORKSHEET

School District: _____
Subject : _____ **Three-Ring Binder:** _____
Book Title : _____
Authors : _____ **Date:** _____
Publisher: _____ **Page Numbers:** _____

Codes: **EF** = Explains Fully **IAE** = Inadequate Explanation
NM = Not Mentioned **ICE** = Incorrect Explanation

1. Explains basic science of acid rain.
_____ a. Explains naturally acidic rain.
_____ b. Explains how sulfur dioxide emissions increase acidic levels of rain, snow, etc.
_____ c. Explains the pH scale.
2. Explains Acid Rain Thesis.
_____ a. Explains theory that acid rain is harmful to streams and lake.
_____ b. Explains theory that acid rain kills fish, trees, crops, etc.
_____ c. Explains theory that acid rain harms buildings, statues, etc.
_____ d. Explains theory that acid rain is so severe that it requires government regulation.
_____ e. Explains that acid rain is a worldwide problem. (Europe)
3. Explains the arguments of the critics of the Acid Rain Thesis.
_____ a. Covers naturally acidic waterways in areas remote from industrial pollution.
_____ b. Discusses findings of NAPAP study.
_____ Little damage to trees and crops.
_____ Minimal damage to streams and lakes.
_____ Recommends against expensive government regulation because costs outweigh benefits.
_____ c. Explains alternative explanations for damage — slash and burn farming in the 1800s.

_____
_____
_____

AMERICAN FOREST WORKSHEET

School District: _____
Subject : _____ **Three-Ring Binder:** _____
Book Title : _____
Authors : _____ **Date:** _____
Publisher: _____ **Page Numbers:** _____

Codes: **EF** = Explains Fully **IAE** = Inadequate Explanation
NM = Not Mentioned **ICE** = Incorrect Explanation

1. Explains the arguments for public ownership of forests.
_____ a. Professional and scientific management of forests.
_____ b. Private sector was over-cutting the forests.
_____ c. Establishment of the National Forests, National Parks, Wilderness Areas, etc., to protect forests.
2. Explains the arguments on how private ownership protects and expands forests.
_____ a. Explains the weaknesses of government management — responsive to special interests.
_____ b. Explains private sector contributions to reforestation — tree farms, replanting.
_____ c. Explains the importance of wood for America's early economic development.
_____ d. Market prices cause conservation, substitutes, and replanting.
_____ e. Currently, grow more wood than cut every year.

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ENDANGERED SPECIES WORKSHEET

School District: _____
Subject : _____ Three-Ring Binder: _____
Book Title : _____
Authors : _____ Date: _____
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Endangered Species Science

1. Explains the Catastrophic Species Loss Theory (CSLT).
   _____ a. Species loss due to human population explosion.
   _____ b. Rain Forest Island Biogeography Theory.
   _____ c. Importance of species in production of medicines.
2. Explains the arguments of the critics of CSLT.
   _____ a. Species are being lost, but not at the high rates predicted by CSLT.
   _____ b. Explains criticism of island biogeography.

How to Save Species

3. Explains saving species by government action.
   _____ a. Save by strong anti-poaching laws and establishment of parks and preserves.
   _____ b. International bans on animal products (elephant tusks, rhino horns, etc.).
   _____ c. Endangered Species Act (ESA) is successful law in the US which saves endangered species.
4. Explains saving species by economic incentives and individual action.
   _____ a. Species lost because of "common property" incentives.
   _____ b. Negative side of ESA — creates incentives which harm species.
   _____ c. Promote ownership and private actions to help species.

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ENERGY AND NATURAL RESOURCES WORKSHEET

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1. Explains the arguments for government-based resource regulation and allocation.
   _____ a. Government action is necessary to prevent shortages.
   _____ b. Overpopulation will cause all resources to be used up.
   _____ c. Need government regulations to protect the environment.
2. Explains the arguments for market-based resource production and allocation.
   _____ a. Resources are not scarce — prices are falling or level.
   _____ b. Price increases cause conservation, increased exploration, shift to alternatives, and the invention of new ways of providing the same service.

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GLOBAL WARMING WORKSHEET

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1. Explains the science of the "Greenhouse Effect."
   _____ a. Carbon dioxide and other greenhouse gases trap the Sun's radiation, which warms the Earth.
   _____ b. Carbon dioxide and other greenhouse gases have increased in the atmosphere.
   _____ c. There has been a slight warming over the last 100 years.
2. Explains the Global Warming Theory.
   _____ a. This theory is based on computer models.
   _____ b. Carbon dioxide is "causing" global warming.
   _____ c. This warming will produce harmful changes in the climate and weather (droughts, ice caps melting, coastal cities flooding, etc.)
   _____ d. This problem requires government action to reduce burning of fossil fuels.
3. Explains the arguments of the critics of the Global Warming Theory.
   _____ a. Explains the weaknesses of computer models.
   _____ b. Warming was before 1938 — CO_2 build-up has been since 1938.
   _____ c. Role of water vapor including clouds in regulating the Earth's temperature.
   _____ d. Some warming may be beneficial. Night-time temperatures, crop growth, more rain.

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OZONE DEPLETION WORKSHEET

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1. Explains ozone facts.
   _____ a. Ozone is an unstable molecule of three atoms of oxygen.
   _____ b. The ozone layer is a thin layer of molecules in the stratosphere.
   _____ c. Ozone is constantly being created and destroyed in the atmosphere.
   _____ d. Ozone absorbs harmful UV rays.
2. Explains the ozone depletion thesis.
   _____ a. The ozone layer is being destroyed by CFCs and other man-made products.
   _____ b. The ozone hole over Antarctica is an indicator of the danger.
   _____ c. If ozone layer is destroyed or thinned, will increase skin cancer, etc.
   _____ d. Danger is so great that governments must take action to abolish CFCs (conversions of all A/C units, etc.).
3. Explains the arguments of the critics of the ozone depletion thesis.
   _____ a. Ozone is highly variable so it is hard to determine if man is influencing it.
   _____ b. Ozone changes may be linked to sunspot cycles, not man-made products.
   _____ c. The so called ozone hole over Antarctica has produced little or no harm to the environment.
   _____ d. Increases in UV radiation reaching the earth have not been measured.
   _____ e. The predicted increases in UV are so small to equal the increase experienced by moving 60 miles north or moving to a city in the mountains.

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POPULATION AND FOOD WORKSHEET

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1. Explains the Neo-Malthusian theory.
_____ a. World population is increasing at rates faster than the earth's ability to feed.
_____ b. Population will exceed the "carrying capacity" of the Earth.
_____ c. Increased population will cause massive pollution problems.
_____ d. Overpopulation causes poverty.
_____ e. Overpopulation will cause the earth to run out of irreplaceable fossil fuels, metals, and minerals.
_____ f. Problem requires government action to limit population; family planning, mandatory programs, i.e., China.

2. Explains the arguments of the critics of Neo-Malthusian theory.
_____ a. Population growth rate peaked in the late 1960s and is decreasing.
_____ b. Applying the concept of "carrying capacity" to humans is inappropriate.
_____ c. Starvation in Africa caused by politics and war, not food growing capacity.
_____ d. Economic growth is best way to limit population; the West is level or decreasing.
_____ e. High population levels do not cause poverty; Hong Kong, Japan, Singapore.

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RAIN FOREST WORKSHEET

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1. Explains the excessive rain forest destruction thesis.
_____ a. Figure for a high rate of rain forest destruction is given.
_____ b. Overpopulation and poverty is given as the reason for rain forest destruction.
_____ c. Explains that rain forest land is not suitable for agriculture and grazing.
_____ d. Creation of carbon dioxide through burning and destruction of trees — contributes to global warming.
_____ e. Loss of species is great with dire consequences.
_____ f. International governmental actions necessary to solve problem.

2. Explains the arguments of the critics of excessive rain forest destruction thesis.
_____ a. Provides data which questions the high rate of rain forest destruction.
_____ b. Use of rain forest natural resources is necessary for economic development and is temporary — minimal long-term damage.
_____ c. Actions by drug companies to save species and "debt for nature" programs.
_____ d. Governments and international organizations are the problem — they provide incentives for inappropriate development of the rain forests.
_____ e. Increased economic development diversity of these nations will relieve the pressure on their reliance on natural resources.

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RECYCLING WORKSHEET

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1. Explains the full cycle of recycling.
_____ **a.** Recycling is not completed until the recycled products are made into new products and those products are purchased in stores.
2. Explains the government-based recycling arguments.
_____ **a.** Recycling is important because it conserves energy, natural resources, and landfill space.
_____ **b.** These goals are so important that they cannot be left up to the market to handle — must have government participation and incentives to encourage — i.e., mandatory curbside recycling, etc.
_____ **c.** Americans are especially wasteful — more wasteful than people in foreign countries — they produce less waste and recycle more.
_____ **d.** Americans must change their over-consumptive ways and Reuse, Reduce, and Recycle (RRR).
3. Explains market-based recycling.
_____ **a.** The best way to take all factors into account in recycling is to leave it to the market., i.e., energy used to haul recycled products vs. energy to produce new products, etc.
_____ **b.** Mandatory programs often impose costs on consumers and taxpayers which are not accounted for in determining costs — and other unintended consequences.
_____ **c.** Landfill space, with all its problems, is often cheaper than recycling.
_____ **d.** Americans are not necessarily more wasteful than foreigners — Mexico study by Rathje.

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SOLID WASTE WORKSHEET

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1. Explains the solid waste crisis arguments.
_____ **a.** Landfills are being closed and new ones not opened — will run out soon.
_____ **b.** To save landfill space, government should ban products — styrofoam, diapers, etc.
_____ **c.** Americans are especially wasteful — more than foreigners.
_____ **d.** Must have mandatory recycling.
_____ **e.** Landfills create ground water pollution and other problems.
2. Explains the arguments of the critics of the solid waste crisis.
_____ **a.** Landfill space is a political problem (NIMBY) not a lack of physical space.
_____ **b.** Need economic incentives to encourage people to accept new landfills.
_____ **c.** The number of landfills closing and opening is meaningless because old landfills should close (less safe for environment) and new ones are safer and bigger.
_____ **d.** Biodegradable is meaningless because in most landfills nothing degrades — or degrades very, very slowly.
_____ **e.** Americans not more wasteful — Rathje's Mexico study.
_____ **f.** Solution — create incentives to reduce trash by charging for trash by volume.

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About the Institute

The Wisconsin Policy Research Institute is a not-for-profit institute established to study public-policy issues affecting the state of Wisconsin.

Under the new federalism, government policy increasingly is made at the state and local levels. These public-policy decisions affect the lives of every citizen in the state. Our goal is to provide nonpartisan research on key issues that affect citizens living in Wisconsin so that their elected representatives are able to make informed decisions to improve the quality of life and future of the state.

Our major priority is to improve the accountability of Wisconsin's government. State and local governments must be responsive to the citizenry in terms of the programs they devise and the tax money they spend to implement them. Accountability should apply in every area to which the state devotes the public's funds.

The agenda for the Institute's activities will direct attention to and resources to the study of the following issues: education, welfare and social services, criminal justice, taxes and spending, and economic development.

We believe that the views of the citizens of Wisconsin should guide the decisions of government officials. To help accomplish this, we will conduct semiannual public-opinion polls that are structured to enable the citizens to inform these officials about how they view major statewide issues. These polls will be disseminated through the media and made available to the general public and the legislative and executive branches of state government. It is essential that elected officials remember that all of the programs established and all of the money spent comes from the citizens of Wisconsin and is made available through their taxes. Public policy should reflect the real needs and concerns of all of the citizens of the state and not those of specific special-interest groups.

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